COAL AGE

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ENEMIES WITHIN

BY FLOYD W. PARSONS

IT IS unfortunate that there can be no powerful government or great industry without its traitors. Often such enemies are fanatics who believe they are right while all others are wrong. The anarchist who plants a bomb to correct a seeming injustice risks his neck and is an honest gentleman compared to that Judas in the coal industry who today is allowing the shipment of dirty coal, and accepting record prices for a product he couldn't possibly sell in normal times.

"That's strong language," you say; and I reply, "It isn't strong enough to fit the case." Furthermore, let it be understood I wouldn't make such an accusation if I hadn't seen with my own eyes many times in many places instances of such a reprehensible practice. Yesterday I saw 60 tons of coal that cost a lot of money that couldn't even be burned without being mixed with real coal of decent quality.

The dishonest clerk who short-changes his customer is a thief, but he only hurts a few people and harms himself most. Here is what the dishonest coal shipper does today:

He is damning an industry that has developed through the exercise of greater individual courage and the endurance of more personal hardship than any other important business.

He is causing the finger of public condemnation to be pointed at honest, conscientious coal operators who have spent a lifetime in the organization and development of reputable mining companies.

He is wilfully and certainly bringing about a situation that can have no other outcome than to deprive efficient mining men of control of their own business, and to hasten government direction of mining, if not Federal ownership.

HOWEVER, these are only a few of the little things. Here is something more serious:

The very existence of this United States depends on our overthrowing German autocracy. The weak link in our entire war program is transportation. This deficiency in the last three weeks has caused our nation a billion-dollar loss through suspended effort.

HERE is what the dishonest coal shipper accomplishes.

The railroads of the United States haul about 1800 million tons of freight yearly; approximately 35 per cent. of this freight is coal. Some coal is sold locally and considerable is used at the mines. Assuming that 630 million tons will be shipped over the railroads this year, it will require 12,600,000 fifty-ton cars to move this output.

If numerous recent investigations are at all accurate, there is at least 9 per cent. additional adulteration in the coal now being shipped in America. It follows, therefore, that if the Nation's total coal output today carries 18 per cent. refuse, this same production has but 63 per cent. of the fuel value of coal carrying 6 per cent. ash, and requires the transportation of 37 per cent. more coal than is necessary. In certain localities the transportation facilities, due to dirty coal, are being taxed as much as 35 per cent. above normal requirements.

With coal carrying 6 per cent. ash, eight boilers are required to generate 300,000 lb. of steam per hour. With 20 per cent. ash, 19 boilers are required. A certain tonnage of coal running 6 per cent. in ash requires 11 cars to transport it; coal having the same fuel value, but running 20 per cent. ash, requires 17 cars to move it.

FOR every additional 1 per cent. of impurities in the Nation's annual coal production the railroads must haul more than five million tons of useless waste. Coal adulteration means more boilers, more firemen, increased fuel demand and more ash handlers. It is further true that as the percentage of ash in coal increases the percentage of combustible matter lost in the ashes increases.

It is physically impossible to mine and market coal that contains no noncombustible matter, but when the impurities in our total production average more than 10 per cent., a despicable crime is being perpetrated. The coal industry must rid itself of the pirates that would destroy it, and it is urgent that effective action be taken at once.

IDEAS AND SUGGESTIONS

Motor Troubles with Undercutters

BY FRANK HUSKINSON
Trinidad, Colo.

Recently I had two odd cases of trouble with the motors of two new coal undercutting machines that had just arrived from the factory.

One of the undercutters gave considerable trouble with the armature and bearings. The bearings would heat unduly, and the brushes would spark. The motor in general did not operate properly. Tests were made, and everything seemed to be all right. The armature was taken out and tested for a sprung shaft; the electrical connections were all gone over and traced out; all with the same result—everything was O. K. Finally a new armature was put in, but the result was no better. New fields were also put in, but no improvement in operation was obtained.

I was upon the point of referring the trouble to the factory, when I thought I would take the motor apart once more and thoroughly examine everything to make sure that nothing had been overlooked. This I did, and among other things I calipered the distance between the center line of the motor and the pole-pieces. I found that one of the pole-pieces was approximately $\frac{3}{16}$ in. closer to the center line than the other. I took out this pole-piece and removed $\frac{3}{16}$ in. from the flat side. On putting it back in the motor frame and calipering again, I found that both pole-pieces were the same distance from the center line of the shaft. The motor was then reassembled and tried out. It worked satisfactorily and never gave any more trouble.

The trouble resulting from the one pole-piece being so much closer to the armature than the other, made itself evident in the shape of a strong pull on one side of the armature and a considerably weaker one on the other side. In fact the longer pole-piece barely cleared the armature, while the opposite pole-piece had slightly more than $\frac{3}{16}$ in. of air gap. This caused the armature to be out of balance magnetically, and when the current was applied to the motor it had a tendency to drag the armature closer to the large pole-piece than to the small one, causing an undue pressure upon the bearings and making them heat. Also, on account of the armature being so much out of balance magnetically, the brushes sparked and the motor did not work properly under a load. Under no load the trouble was not so noticeable. The air gap between the pole-pieces and the armature was not visible in this motor, it being of the inclosed type.

Another odd case of trouble with a new machine that had just been put in operation was one where the motor would not run without excessive heating of the armature bearings. Upon a thorough examination it was found that the front endplate that contained the armature bearing and brush frame was not properly planed and fitted to the motor casing. It was out of true approximately $\frac{1}{8}$ in. on one side, so that when assembled the front armature bearing was not in line with the armature shaft. The result was that the shaft was practically clamped tight in the bearings when the motor was assembled. This caused excessive friction, resulting in the bearings becoming unduly heated in a short time.

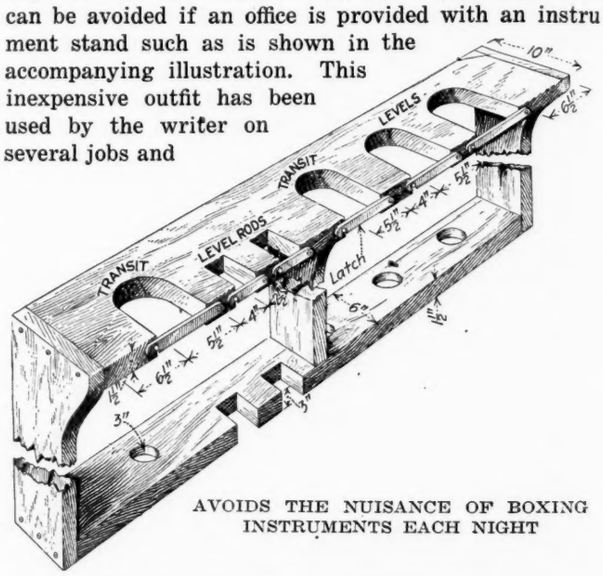
After properly lining up the front plate with the armature and motor casing, the motor gave good service and satisfaction.

The foregoing two cases of trouble with machines of the latest type and of a standard and reliable make are unusual, especially in a new machine. They evidently show that the best of us are liable to make mistakes.

Why Box Instruments Every Night?

BY GEORGE W. MCALPIN

All the trouble and waste of time in removing surveying instruments from their tripods and placing them in their boxes at the end of the day's work can be avoided if an office is provided with an instrument stand such as is shown in the accompanying illustration. This inexpensive outfit has been used by the writer on several jobs and has been found satisfactory in every case. The construction is simple. Slots cut into a 1½ x 10-in. plank provide recesses into which the tripods and levels may be set. The tripods are then held in the slots by metal latches hinged at one side and fitting over a nail at the other. The feet of tripods and the lower ends of level rods fit into holes cut in another plank set lower.—*Engineering News-Record.*



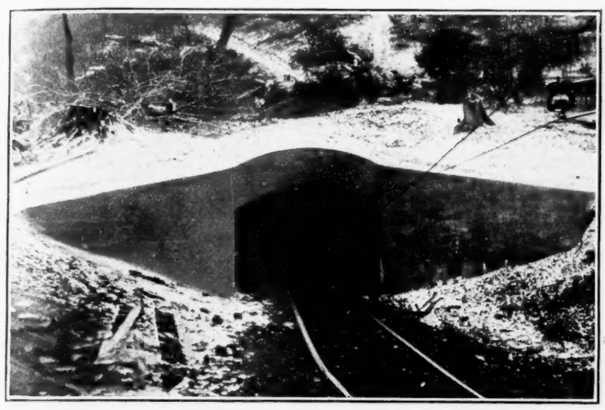
AVOIDS THE NUISANCE OF BOXING INSTRUMENTS EACH NIGHT

The hardening of concrete is not a drying process as some suppose. If concrete, after being placed, is left exposed to sun and wind, much of the water necessary to its hardening is lost by evaporation. Protection, says "The Ransome Book," is especially necessary on walls and floors, where a large surface area is exposed. It is not so necessary on mass work.

Concrete and Tile Lining for Headings

The Clearfield Bituminous Coal Corporation, at its coal operations in Pennsylvania, has a number of slopes and main headings which will be used for a number of years. As fast as the old timbering in these slopes and headings decays, the company replaces them with permanent linings of concrete and tile.

The old timbers *A*, in Fig. 2, are set on 4-ft. centers. The space between these timbers is filled with concrete



ENTRANCE TO HEADING, LINED WITH CONCRETE AND TILE

to a height of 5 ft. 8 in. from the top of the old mudsill *B* in Fig. 2. When the concrete has set the small post *C* is placed on top of the concrete and the 35-lb. T-rail *D* is placed across the heading from this post to a corresponding post on the other side. This T-rail supports the lagging when the cap piece *F* is removed, and as the work progresses is moved forward to catch the next set of lagging at *E*, and so forth. When the lagging is supported by the T-rail, the cap piece *F* and the post *A* as far as the top of the concrete *G* are removed. The support *H*, as in Figs. 1 and 2, is then set in place and the form *I*, as in Figs. 1, 2 and 3, is placed on top of this support.

On this form chimney bricks are placed in the position shown at *J*, in Fig. 1. These bricks are made of tile and are $6\frac{5}{8}$ x $5\frac{3}{4}$ x 9 in., and are so designed that they make a perfect arch of a radius of 5 ft. Over the top of the brick a covering of $\frac{1}{2}$ in. of concrete is placed. The space between the top of the arch and the lagging is carefully packed with rock.

When the arch is set the form is moved up and a new set of brick is put in place. Every time the form *I*, in Fig. 3, is moved up an advance of 20 in. has been made. The old timbers *A*, in Fig. 2, which were not removed are then taken out and the space filled with concrete.

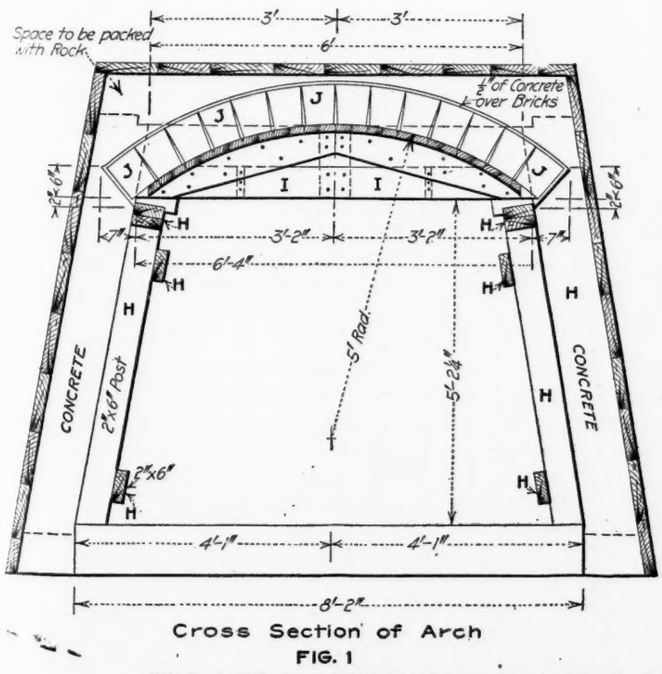
Power Loss in Coal Mines

BY J. J. NOLAN
Linton, Ind.

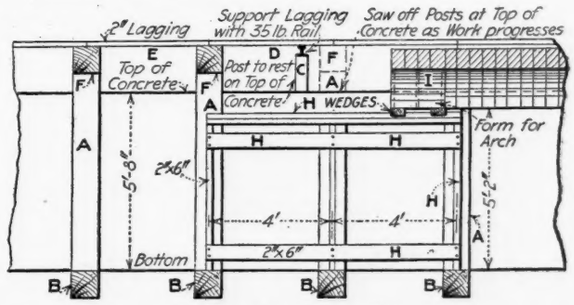
Here is a scheme I tried at one of the Vandalia Coal Co.'s mines near Linton, Ind., to increase the power in the bottom.

As is well known, the return is always more or less neglected, frequently containing bad bonding, poor connections, etc. I connected a 4/0 wire from the high-speed engine bedplate to the negative side of the switchboard. With a portable ammeter and with a 1600-amp. load on the switchboard, I got a reading from the bedplate to the negative side of the board of 550 amperes.

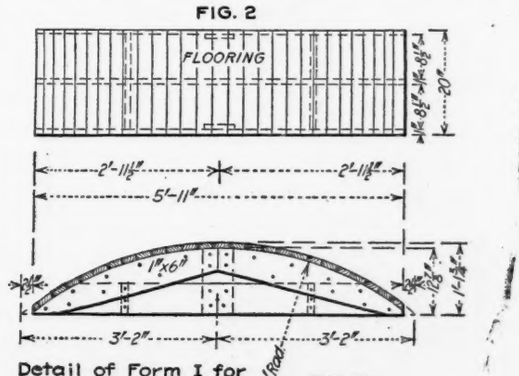
Since then similar connections have been made at six other mines, and readings have been taken in each case with portable ammeters. These showed from 275 to 550 amp. with normal load on the board. In one instance a 2/0 wire was used, but this became too hot to handle a few minutes after connecting.



Cross Section of Arch
FIG. 1



Elevation - showing Forms
FIG. 2



Detail of Form I for Arch
FIG. 3

FIGS. 1 TO 3. CONSTRUCTION DETAILS OF RELINED ARCH, SHOWING FORMS USED

Blacksmithing at Coal Mines

By J. F. SPRINGER
New York City

SYNOPSIS — Steel is structurally complicated, its structure and strength depending not only upon the percentage of carbon present but upon the working and the heat treatment to which it has been subjected. Steel loses its magnetic capacity at the temperature about right for hardening. Various molten baths may be advantageously used for tempering.

ALTHOUGH the various steels used in a coal mine are not subjected to the same service as is the rock-drill steel used in metal mines, still this is no real reason why more attention should not be given the former than is now customary. In most coal mines there is no system that requires the steel to be handled in the blacksmith shop in a really modern manner. That the owners lose money by this neglect can hardly be doubted. Because the ordinary blacksmithing operations suffice to produce good results when the tools are used in the coal is not a strong reason against getting still better results.

Only a small number of coal-mining blacksmiths really are familiar with the up-to-date methods of forging and hardening. I refer more particularly to the manner of using heat. The purpose of this article is to furnish the necessary information to two classes—the superintendents or foremen responsible for output and the cost of getting it, and the boss blacksmiths and their subordinates.

Should Know How Blacksmithing Work Is Done

A superintendent or a foreman should know exactly how certain blacksmithing work must be done and why it should be done in one way rather than in another. If he does not possess this information he will be at a serious disadvantage in discussing correct methods with the men who do the actual blacksmithing or have immediate control of those who do. The second class I referred to—the men in the blacksmith shop—obviously need the information for use in their daily work.

Some persons are of the opinion that to know how to do a thing is enough, and that to know why a thing is done is not especially important. This opinion, however, is most certainly wrong. The right way of doing a thing sometimes occasions more trouble than one of the wrong ways, and it is human nature to follow the easier road. If it is not explained to a workman why the longer road is the better, he is likely to lose his cheerfulness if urged to take it. If he understands just why he ought to do a thing one way rather than another, we can expect a greater readiness to follow directions based on these reasons.

Steel is a complicated material. During recent years the miscroscope has made this fact plain. It is now known—and it was not known formerly—where the carbon is located that exists in a piece of steel. In addition, the changes undergone by a piece of steel as it passes through different heats have also been studied. Furthermore, modern methods of testing steel for strength enable us to observe the effects of heating and cooling upon this valuable quality. A large part of this information has a direct bearing upon blacksmithing operations.

Steel is not homogeneous. It is built up of many layers, or particles. Some of these layers are practically pure iron, containing no carbon; other layers, or flakes, have carbon in them. The patches in which the carbon is found are true chemical compounds consisting of iron and carbon. That is, these patches are not mere mixtures of iron and carbon—a particle of iron and a particle of carbon—but combinations of such a character that both the carbon and the iron have lost their identities and a new substance has been formed. This new substance—this chemical compound—is carbide of iron. The metallurgists call it "cementite."

Heat Treatment Differs With Carbon Content

If the steel is in an ordinary annealed state and contains, say, 0.90 per cent. of carbon, it will usually be found that the entire mass will be made up of grains or crystals, each of which will consist of alternate layers of iron and cementite. The layers may be more or less crumpled. The material of which the grains are composed is called "pearlite."

The proper heat treatment of steel differs somewhat with the carbon content; that is, it depends on whether the steel contains more or less than 0.90 per cent. of carbon. This means, therefore, that in this percentage we have a dividing point. If the steel contains more than 0.90 per cent. of carbon then the grains will still be formed of pearlite, but they will be separated from one another by the walls of a honeycomb of cementite. If the steel has less than 0.90 per cent. of carbon there will still be a honeycomb, with grains of pearlite filling its spaces, only now the walls of the honeycomb will be of iron. It is with this quality of steel that we have most to do in coal mines.

Suppose we have a sample of bar steel of 0.90 per cent. carbon or higher. If we take an ordinary horseshoe magnet and apply it to this bar, the two will cling together. Let us now heat the steel, and every now and then apply the magnet. At first the magnetic action will continue to take place, and the magnet will grip the steel; but, as the heating goes on, we reach a point at which the steel loses its magnetic quality. The magnet will then no longer adhere. In fact, the magnetic action has been lost for this and all higher temperatures.

When the steel is cooled it will, after a time, again be attracted by the magnet. The temperature at which the change takes place is about 1275 deg. F. This is an important fact for a blacksmith to know, as he can use it to good purpose when hardening steel.

If the steel contains 0.90 per cent. (or more) of carbon, it can be hardened by heating it to just a little higher than 1275 deg. and then plunging it into cold water. If it is merely heated to a point a little below 1275 deg., it will not harden when plunged into the water. Try it. Use the magnet to tell the temperature.

It so happens that the temperature at which magnetic activity disappears is just about what we want when we harden a piece of 0.90 per cent. carbon steel. As the magnet acts about the same on gloomy days as it does on sunny days, we have, for this particular kind of steel, something better than the color to go by.

In carrying out this procedure, go a little higher—but not much higher—than the point at which the magnet lets go. There are two reasons why we should go a little higher: (1) We want to be a trifle higher in order to be sure of an adequate heat for the hardening, and (2) we must allow something for the cooling that takes place before we can get the piece of steel into the water.

If the steel has less carbon than 0.90 per cent.—and this is the kind of steel the coal mine will rather likely be interested in—then we need to harden at a somewhat higher temperature. It is fortunate—for coal people—that the magnetic point of such a steel is also higher. In fact, the magnetic point and the hardening point are practically in agreement for all steels down to those having 0.50 (perhaps even 0.40) per cent. carbon. A 10c. horseshoe magnet is, accordingly, an excellent pyrometer for the coal-mine blacksmith. When he wants to harden cutter steel, puncher steel and the like, he heats it to the magnetic point and then goes a little higher, in order to be certain he has exceeded the magnetic point and to allow for loss of heat before getting the work into the quenching bath. He then chills the steel, and the hardening is done.

However, if the steel has a still lower carbon content than 0.40 or 0.50 per cent., then the temperature for hardening must be run up to a level higher than the magnetic point of this grade of steel. This kind of steel would be rather soft for cutting tools. What we are now concerned with is the steel used for the bits in chain-cutting machines, in punchers and the like.

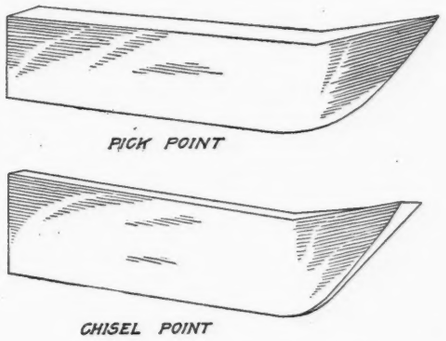
Such tools should be made of carbon tool steel. Steel containing 0.75 to 0.90 per cent. of carbon is understood

TWO-PRONGED PUNCHER BIT

to be advantageous for this purpose. However, the practice varies. Steel containing no more than about 0.40 per cent. carbon seems to have been used. The best grade to employ under most conditions is probably that containing the higher carbon content just given. Such tool steel is not especially brittle, particularly if the temper is properly drawn. It will cost more money, but in all probability will give better service. The magnet may be used with any of these steels to determine the hardening temperature.

Let us return to the matter of the crystals, or grains. When annealed steel of any carbon percentage is heated beyond 1275 deg. F., the grains begin to grow just after the temperature exceeds the 1275-deg. mark and continue growing as the temperature rises. It is possible that growth does not stop until the melting point is just about reached, this growth probably being the union of small grains. How this takes place need not detain us, however, as the important thing for us to know just now is that they grow. It seems to be well established that the bigger the grains of any sample of steel the weaker the steel.

Suppose, for example, we heat a piece of 0.80 per cent. carbon tool steel to 1800 deg F. The grains have been growing for 525 deg. and will be good and large. Whether we chill this piece suddenly or allow it to cool slowly, the grains remain the same in size. Experts seem agreed on this. Consequently, this steel, which has been heated as high as 1800 deg., is damaged metal and is known as "overheated" steel. There is a technical distinction between overheated steel and burned steel. Overheated steel is simply steel whose grain size has suffered enlargement. Unless the grain size is reduced to normal, the steel will remain more or less damaged. But burned steel is steel which has been heated, presumably in contact with the air, until it scintillates. The oxygen of the air appears to unite with some of the carbon in the steel to form carbon monoxide or carbon dioxide. That is, some of the carbon is actually burned out of the metal. Probably this action would not take place if the air were excluded.



TWO TYPES OF CUTTER BITS

Burned steel should be thrown onto the scrap pile. However, the burning may not have extended far. It may, for example, have affected only the tip of a cutter bit. In such a case it may be possible to grind or cut away the part actually damaged.

In general overheated steel may be restored—perhaps not always to its full original condition. That is, the big grains may be made small again and the strength restored more or less perfectly. There are two methods of doing this. One is by hammering or otherwise working the steel. A two-pronged puncher bit is apt to break, if anywhere, diagonally across one of the prongs. Such a break is probably due in part to a failure to restore the quality of the steel by the hammering process that was carried out. The whole prong may have been heated to a high temperature and the grain size greatly enlarged. When the hammering took place, the smith may have given nearly all his attention to the tip, leaving the part back of the tip in its damaged condition or else doing only a little work on it.

The prong would naturally break along a line marking the division between coarse and fine grains. However, the smith should not work steel after it has cooled to too low a point. I doubt whether investigation has gone far enough to warrant an exact temperature being given and insisted upon. At the same time, when

steel has cooled sufficiently to be attracted by the magnet, the smith may do well to be on his guard. Whatever blows are struck below the magnetic point should be light ones.

The second method of restoration is much more thorough and penetrating. This is restoration by annealing. It is a curious fact, but one that has been thoroughly ascertained, that a piece of overheated, big-grained steel will, if heated from below 1275 deg. to a level above that temperature, undergo a change in its grain size. This applies to steels of all carbon percentages.

While it is true that the size of the grain changes, we are not to jump to the conclusion that the size is uniform at any given temperature. For steels whose carbon percentages lie between 0.40 or 0.50 and 0.90, the rule is this: The grain-size changes are complete when the steel reaches the point where the magnet loses its grip. To anneal such steels we start with any temperature below 1275 deg. and heat the work until we are sure the magnet will not exercise its usual power.

Method of Annealing Steels

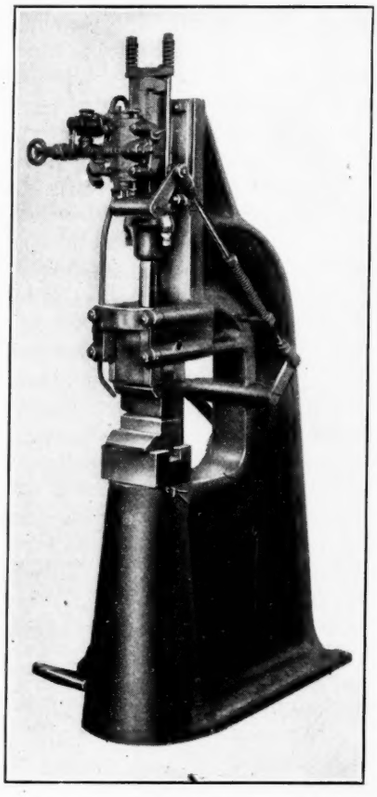
In order to be sure that we are below 1275 deg., which is approximately a full cherry red (perhaps somewhat below), we may let the work cool to a very dark red, to black, or even to the temperature of the shop. It makes no difference where we stop, provided we are below the 1275-deg. point. When we heat up from such a point to the magnetic limit, we will have a grain size corresponding to the temperature at which we stop; that is, the grain size will be small and the strength near its maximum. This is annealing.

A highly important lesson and one that will jolt a good many—not to say the big majority—of smiths is that we are forbidden by the foregoing from hardening the steel with the heat used for forging. It is quite easy and convenient for the smith to heat the work to a forging temperature, and when he has finished hammering to dip the tool into the quenching bath. This is all wrong. If we want the best results, we must get below 1275 deg. and then be on the rise in order to do the annealing. The thing to do is to reconcile one's self to heating the work twice. The first heat is used for forging, the second heating effects the annealing. We then dip the work and do the hardening.

A separate heating for each of the three operations would perhaps be the best procedure, but this is probably too much to expect. It is doubtful whether the additional benefit would be sufficient to warrant the full procedure. It so happens that the temperature at which we should halt the rise for annealing purposes is also the proper temperature for hardening. We take advantage of this and dip the work, thus avoiding the third heating.

The advantage of three heatings would be that the annealing heat could then be prolonged. The work might be packed and so on. It does not seem impossible to do the three heatings at a coal mine. The annealing and hardening operations can quite conveniently be done upon a considerable number of pieces simultaneously, particularly such small pieces as cutter bits.

The bits on a coal cutter may sometimes be purchased from the manufacturer of the cutting machine; but they also may be made in the mine's blacksmith shop from bar stock. The stock should be of the size required for the shank of the bit. Thus the stock may be rectangular bar $\frac{1}{2}$ x $\frac{3}{4}$ in. or $\frac{1}{2}$ x 1 in. in section. A belt-operated triphammer is a suitable forging tool. The bits will ordinarily be rather simple affairs. They may be given a chisel edge or a pick point. The chisel edge may be used to advantage in cutting sulphur sheets or blackjack, if either of these is present in any considerable quantity. But we may use chisel bits in the top and bottom blocks and put pick points in all the other places, provided the coal is fairly clean. The two forms are readily made with a triphammer or by hand. The bar is held in position and shifted until the proper point or edge has been secured and until the desired angle of bend is given to the bit. As bit after bit is forged, the smith should be on his guard lest he be using heavy blows on steel that has cooled to too low a point. There are one or two special forging machines on the market. A type manufactured by one of the leading companies is operated by compressed air. It is used to forge a brand new cutter or to reshape ("resharpen") an old one that has become dull from use. Where compressed air is available this machine is doubtless a fine thing. Steam may be used instead of compressed air, but the manufacturer should be notified of the intention to use steam at the time when the machine is ordered.



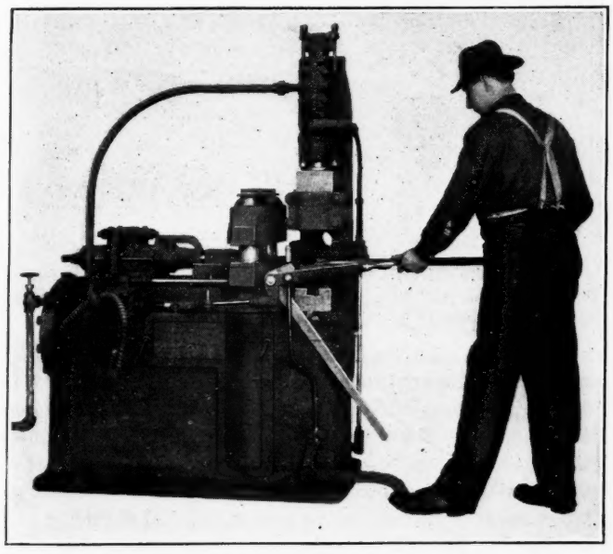
POPULAR TYPE OF MACHINE FOR SHARPENING OF CUTTER BITS

This machine differs from some of the drill bit sharpeners in that it is not necessary to upset the metal. The hammer operates vertically. Either a single blow may be struck or a succession of blows. The severity of the blow may be adjusted to suit the occasion, the operator having this matter under his control. Two swaging dies are employed, one serving as an anvil and the other as a hammer. The dies are of special form to suit the bits. Thus the form used for pick points will differ from that used for chisel edges. The dies are held in place by dovetail tongues which slip into similarly shaped slots. The special cutter-bit dies may be removed readily and ordinary forging dies substituted. The machine is then ready for general service in the blacksmith shop.

It is understood that a single machine can reforge as many as 200 bits an hour, chisel edges or pick points. Probably the bar has to be heated to a high point in

order to get this speed. In that case the job is done so quickly that the work is still highly heated when it is over. This is not good, for the reason that the grain size will naturally be about the size which corresponds to the temperature of the steel at the moment the work stopped.

As the point now under consideration is of importance —especially where only one heating is allowed—and is perfectly relevant whatever style of forging machine is employed, it will be well to have it fairly and squarely before us. The finishing temperature best for 0.50 per cent. carbon steel has been carefully investigated. The probabilities are that other steels behave similarly. Professor Bradley Stoughton cites William Campbell as having studied this type of steel. About 1908 Professor Stoughton, for the steels we are considering, expressed the matter in effect as follows: "Work below the magnetic limit greatly increases the brittleness of the material, while finishing the work at a higher temperature results in lower strength. Upon the evidence at hand, we may tentatively assume like conditions for these medium-carbon steels, and expect the best results if mechanical work is ended when steel is at a temperature which brings it exactly to the magnetic limit, but reserving the right to change this statement slightly when more data are obtained." It should be noted that Professor Stoughton in any event



REPRESENTATIVE FORGING MACHINE USUALLY EMPLOYED FOR ROCK DRILLS

only expects to make a "slight" change in this statement. I may add that in the 1911 edition of his work he allowed the statement to stand.[1]

Accepting this, we see that we will get the best results by not finishing the forging until the magnet takes hold or is about to take hold of the steel. If, however, we are not going to heat a second time, it will be impracticable for us to take full advantage of continuing to forge quite all the way down to the magnetic limit. The reason for this is that we must be above that limit when we harden. And, as already explained, we should see to it that we are allowing something for error and that we allow for the interval between stopping the heating and the plunge into the quenching bath. Consequently, if we forge with or without a machine and are going to omit a second heating, then we should begin with such a temperature as will bring us to the finishing point somewhat above the magnetic limit. With a power-driven machine this temperature of beginning should be lower than would be the case if we forge with a hand hammer on the anvil. In other words, the shorter the time of forging the lower the starting temperature should be.

However, if the work is afterward to be annealed, it would seem permissible to use high temperatures both with hand and machine forging; only we must be careful not to burn the metal. The ease and rapidity with which the work can be done at a high temperature would naturally result in a saving of time. This saving could then go to offset the extra time and trouble required to heat the second time. Let me recapitulate some of the foregoing results in the form of two rules:

Rule 1—If there is to be only a single heating, we heat to such a point as will allow just enough time to do the forging and still have the temperature distinctly above the magnetic point. We hardened instantly.

Rule 2—If there are to be two heatings, we heat to a point considerably higher than allowed by Rule 1 in order to get the advantage of easier forging, cool down to dull red or lower, reheat until distinctly above the magnetic point and then harden.

Tempering of Bits Reduces Brittleness

The tempering of cutter bits and other coal-cutting tools is done for the purpose of reducing the brittleness that exists after an ordinary hardening process. In many cases, perhaps the big majority, no tempering at all will be needed, especially if the hardening and quenching are done with intelligence. There are cases, however, where tempering may be the best solution of the particular problem in hand. Whatever the reason may be why it should be used in any particular case, the fact remains that tempering is a wonderfully successful method of adding to the toughness. There will be a decrease in hardness, but this may not necessarily mean a reduction in cutting ability.

Tempering consists in reheating a piece of hardened steel to a moderate temperature and a subsequent quenching. The hardening process seems to produce a strained condition in the mass of metal. A sudden shock may readily break a piece that has been highly hardened, even though the shock be quite mild. Thus a cutter point may strike a hard spot of some kind when at work and suffer fracture in consequence. If there is much trouble from such causes, tempering may cure it by appreciably reducing the internal stresses in the metal.

In general, the higher the temperature employed in tempering the greater the toughness and the more considerable the loss of hardness. A general rule can hardly be given for cutter points that will secure the best results under all circumstances. The cases will be different, and judgment should be based on the consideration I have just set forth. Some experimentation may be needed to get the cutters to the most efficient temper.

[1] I have changed the statement only to make it apply to the magnetic limit and the steels we have in hand. In Professor Stoughton's text ("Metallurgy of Iron and Steel," p. 377, ed. of 1908, p. 363f, ed. of 1911), the statement is unnecessarily technical for our present use, because he has in view all steels and refers to temperatures as given by degrees Centigrade and Fahrenheit.

After finding what is best, the next consideration is to secure the same result repeatedly. The man who settles the point of proper temperature, for example, may not do all the subsequent tempering.

Perhaps the simplest way to arrange a "foolproof" method of getting the right temperature is to use an alloy bath. An alloy of a given composition will melt at a fixed temperature. Lead and tin are melted together to form a molten bath and the hardened cutters or other tools dipped into it. The accompanying tables give various tempering colors, the corresponding pyrometer degrees and the composition of the suitable alloy.

LEAD-TIN TEMPERING BATHS

Color	Deg. F.	Tin Lb.	Tin Oz.	Lead Lb.	Lead Oz.
Faint straw	430	1	0	1	14
Straw	460	1	0	2	6
Light brown	490	1	0	3	8
Dark brown	500	1	0	4	2
Light purple	530	1	0	7	8
Dark purple	550	1	0	12	8

As antimony costs less than tin per pound, we may perhaps prefer to alloy the lead with it. The following table exhibits the fusion temperatures for various mixtures:

Deg. F.	Antimony, Per Cent.	Lead, Per Cent.
554	5	95
518	10	90
482	13	87

The question may properly be asked: How are we to keep these baths from getting too hot? After an alloy, or almost any metal, has been heated to the melting point, it is possible to go on raising the temperature. To meet this difficulty, we first find what alloy we are going to use. Suppose it is the one corresponding to the straw color. The alloy should contain the two metals in the proportions of 1 lb. of tin to 2 lb. 6 oz. of lead. We may prepare our alloy in the form of blocks or ingots. When a bath is wanted it will only be necessary to melt the ingots. At the time the ingots are got ready we cast a number of rods of small diameter, but in these we use somewhat more lead and not the relative amount used in the bath. This will have the effect of giving the rods a higher melting point. This may be seen by noting in the table how the temperature goes up with the increase in lead.

When the ingots have melted and the bath is thought to be just about ready, we test the temperature by dipping one of the rods into the bath. If the end of the rod melts, we regard the bath as too hot; if it refuses to melt, we regard the bath as at the proper temperature. All this is easy to carry out, both as to getting the ingots and rods ready and as to testing the bath afterward with one of the rods.

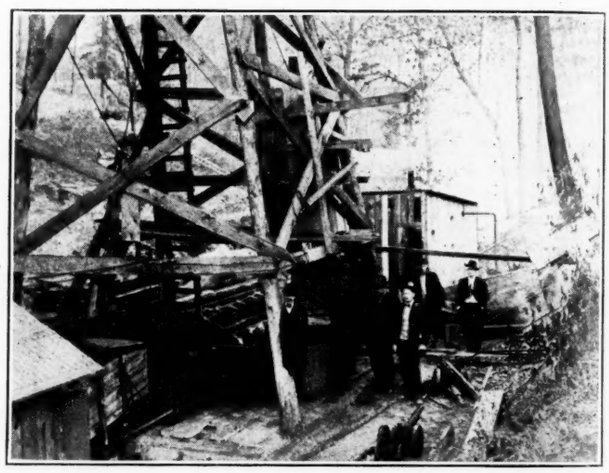
Record Shaft Sinking in West Virginia

The accompanying illustration shows the temporary headframe over the air shaft of the Rachel Coal Co., at Broomfield, W. Va., where a record was made in shaft sinking. The shaft is 370 ft. in depth to the bottom of the Pittsburgh No. 8 seam, which here attains a thickness of 8 ft. At a depth of 252 ft. the bottom of the Sewickley seam was reached. This was found to have a thickness of 5 ft. The Sewickley and Pittsburgh beds are separated in this shaft by 110 ft. of fireclay, limestone, sand-rock and various slates. The air shaft is 12 ft. in diameter.

The material encountered in sinking this shaft is shown in the following section, furnished by General Manager E. F. Miller:

	Feet		Feet
Surface and sand	27	Sandstone	18
Limestone	15	Fireclay	6
Fireclay	5	Brown slate	15
Limestone	7	Sewickley seam (bottom of seam 252 ft.)	5
Fireclay	22	Fireclay	36
Shale	16	Limestone	13
Limestone	5	Brown slate	4
Shale	15	Sandrock	22
Limestone	9	Brown slate	20
Blue shale	26	Black slate	15
Limestone	17	Pittsburgh No. 8 seam	8
Shale	2		
Limestone	2		
Fireclay	3	Total	370
Limestone	37		

Ground was broken for this shaft on June 11, 1917, and the first car of coal was loaded on Sept. 1, 1917—a fine record. Nine D. P. Sullivan No. 33 Jackhamer drills were used in sinking the shaft and the management—E. F. Miller, general manager, and J. C. Edwards,

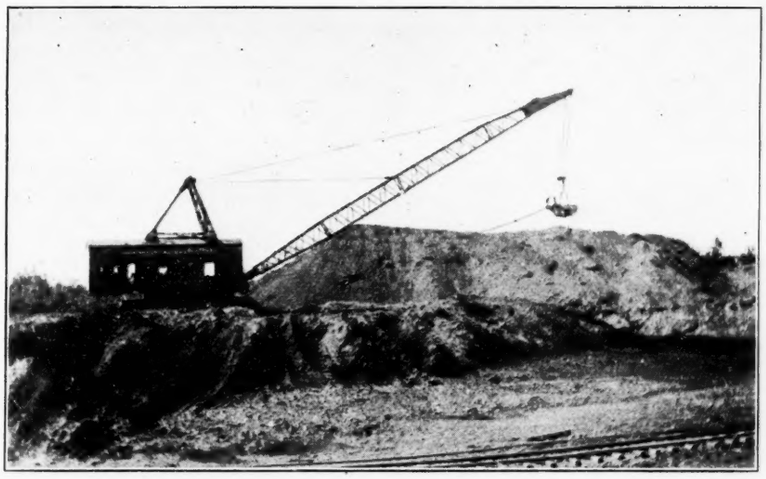


TEMPORARY HEADFRAME OF RACHEL COAL CO., BROOMFIELD, W. VA.

superintendent—states that the work could not have been completed as quickly except for the Jackhamers. The average number of men working per shift was seven, 3 shifts being worked per day—all company work. Ventilation was effected by a 4-ft. Robinson fan, the air being carried down the shaft in a 12 x 15-in. tongued-and-grooved wooden compartment. Forty-five feet of the shaft was concreted; 5-ft. section wooden forms were used. The concreting was completed with the original forms, on which there were no repairs.

Screen Gravel for Concrete

Gravel as found in a natural bank, "bank-run gravel," as it is termed, is not suitable for concreting without being properly screened. It usually contains twice as much fine material as coarse, while the proportions should properly be reversed. The natural run-of-bank gravel, says "The Ransome Book," contains 45 per cent. of voids or air spaces. To fill these and make a dense concrete, the amount of sand should be about half the volume of pebbles. If more sand than this is used, as would be the case when the bank-run material is employed exactly as coming from the pit, it is necessary to use a much greater quantity of cement to fill up these voids or air spaces so as to give the concrete the desired strength, which is uneconomical of cement.



Electric Control of a Dragline Excavator

By L. W. NICKEL
Now Serving in the United States Navy

SYNOPSIS — *The dragline excavator possesses certain obvious advantages over the steam shovel. Electrical driving permits operation with fewer men and insures against delays arising from cold weather.*

ONE of the most interesting applications of electric control in a field where reliability is essential can be found in the control of a dragline excavator. A machine controlled in this manner has recently been installed at the works of the Locust Mountain Coal Co., Shenandoah, Penn., and is shown in the leading illustration. This excavator is used for stripping a coal bed, the stripping being from 14 to 30 ft. in depth. The rock encountered in the stripping process is drilled by steam drills and then shot. With the dragline in one position it is possible to take a cut 150 ft. in width. Spoil banks are always dropped on surface which does not contain coal; that is, the excavator is always placed directly over the vein and is followed by a steam or electric shovel. The dragline method of stripping has been found to be much cleaner than any other, as no rock or dirt is spilled on the coal when once it is cleaned. This is not the case where it is necessary to run locomotive track for disposing of rock and dirt taken off the surface.

With an electrically operated dragline no fireman, coal passer or pipe man is needed. Further, there are no steam or water pipes to freeze, and on the coldest mornings no delay is experienced in starting the stripping operation, it merely being necessary to close the main-line switch and commence work. The only labor required for the operation of this machine is the dragline operator, an oiler and a few men in the pit; whereas where stripping is being done by means of steam shovels and the dirt and rock is hauled away by locomotives, the amount of labor required is increased six or seven times.

The dragline excavator under discussion has a turntable 24 ft. in diameter, a 150-hp. hoist motor and a 75-hp. swing motor. The turntable consists of 40 openhearth steel rollers revolving between two 90-lb. rail circles, 24 ft. in diameter, one attached to the bottom of the revolving frame and one to the top of the base.

The main machinery is driven by a 150-hp., 440-volt, slip-ring-type motor, operating at a speed of 565 r.p.m. This motor drives two drums, one of which winds the rope that drags the bucket through the dirt while the other operates the rope by means of which the bucket is hoisted. There is also a small drum for raising and lowering the boom.

The swinging machinery is operated by a 75-hp., 440-volt, slip-ring-type motor, driving a vertical swinging shaft through three gear reductions. A pinion on the vertical shaft engages the circular swinging rack on the base. The master controllers, brake levers, etc., are mounted at the front of the machine so that the operator can manipulate the excavator without danger to the pitmen.

The bucket has a capacity of 3½ cu.yd. and is suspended by a three-part hoist. It is dumped by locking or holding the third, or single, part of the hoisting line. This is attached to the front end, or arch, of the bucket, after which continued hoisting dumps the contents. The brake, or holding device, consists of a drum, with a spring-actuated pawl and ratchet located near the front of the boom and controlled from the operator's platform on the revolving frame.

The magnetic control panel for this equipment was furnished by the Cutler-Hammer Manufacturing Co., of Milwaukee, Wis. It consists of double-pole magnetically operated switches equipped with series relays. The master drums, which are mounted over the operator's head, are of the bevel-gear type equipped with punched brass fingers having a forged copper tip so designed as to prevent stubbing of the finger. The main motor controller is equipped with jamming relays so operated

that the resistance is automatically cut into the rotor circuit when the motor is stalled. The maximum current taken by the motor under these conditions will not cause the circuit breakers to open. Thus the operator has control over the motor while it is stalled. This feature of stalling the motor and providing absolute protection makes it possible to obtain digging characteristics similar to those of a steam-actuated machine.

The controller for operating the swing motor is equipped with a plugging switch so that it is possible for the operator to throw the controller quickly to the maximum speed position and to reverse at full speed. The current inrush during this plugging period operates the series relay having control of the plugging switch, and in this way resistance is cut into the rotor circuit of the swing motor, so that the motor is fully protected during the plugging period. Because of the momentum of the boom on an equipment of this kind it is not necessary, under ordinary conditions, to reverse at full speed ahead, inasmuch as the operator often throws the controller to central position at approximately 20 deg. ahead of the dumping pile, the momentum carrying the boom to this point, at which time the motor is plugged. The grid resistance for the motors is mounted at the rear of the control boards in open frames thoroughly protected and ventilated.

TABLE I. COST OF STRIPPING 256,710 CU.YD. DURING YEAR 1915

Classification	Labor		Material		Total Cost
	Amount	Per Yd.	Amount	Per Yd.	Per Yd.
Shovel crew	$1,463.50	$0.0057	$82.26	$0.0003	$0.0060
Pitmen	1,697.80	.0066	5.16	.....	.0066
Blasters	107.02	.0004	1,804.22	.0070	.0074
Repair and maintenance	317.08	.0012	1,274.89	.0050	.0062
Electric repairs and maintenance	318.64	.0012	16.24	.0001	.0013
Transmission lines	74.56	.0003	7.60	.....	.0003
Power	.....	.....	2,038.26	.0079	.0079
Foremen, etc	339.16	.0013	2.25	.....	.0013
Clerk	40.50	.0002	.....	.....	.0002
Hauling	36.73	.0001	.....	.....	.0001
Miscellaneous	1,664.13	.0065	13.00	.0001	.0066
Total	$6,059.12	$0.0236	$5,243.88	$0.0204	$0.0440
Credit account timber, cutting brush, charged into colliery warehouse	427.25	.0017	.....	.....	.0017
Grand total	$5,631.87	$0.0219	$5,243.88	$0.0204	$0.0423

TABLE II. COST OF STRIPPING 56,565 CU.YD. DURING OCTOBER, 1915

Classification	Labor		Material		Total Cost
	Amount	Per Yd.	Amount	Per Yd.	Per Yd.
Shovel crew	$391.97	$0.0069	$23.25	$0.0004	$0.0073
Pitmen	439.42	.0078	.....	.....	.0078
Blasting, repairs and maintenance	69.84	.0013	433.50	.0077	.0090
Electric repairs and maintenance	100.71	.018	50.34	.0009	.0027
Transmission lines	40.77	.0007	.79	.....	.0007
Power	.....	.....	369.67	.0065	.0065
Foreman, etc	111.86	.0019	.....	.....	.0019
Clerk	45.17	.0008	.....	.....	.0008
Hauling	79.25	.0014	.....	.....	.0014
Miscellaneous	157.61	.0028	53.34	.0010	.0038
Total	$1,435.90	$0.0254	$930.89	$0.0165	$0.0419

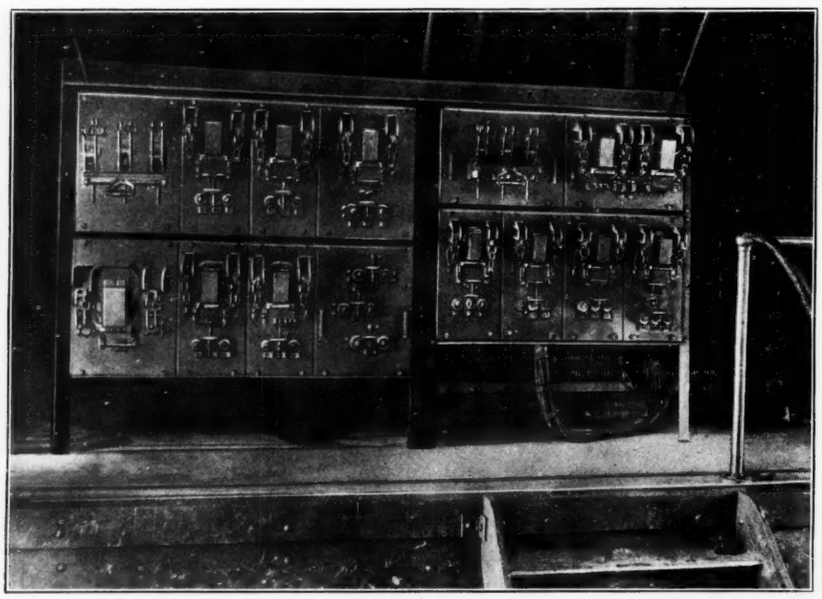
The power for this installation is furnished by the Harwood Electric Co.'s plant at Hazleton, Penn., 22 miles distant. It is transmitted at 25,000 volts to Shenandoah, where it is stepped down to 4000 volts and is again stepped down to 440 volts by the Locust Mountain Coal Co., at its strippings, so that when brought to the dragline system it is three-phase, 440-volt, 60-cycle current. The transformers are mounted on a wagon.

The current is commutated to the machine by means of a collector-ring equipment consisting of three copper rings mounted concentric with the center casting of the machine and revolving with it. Heavy brass brushes to which the cable is attached are anchored onto the machine, there being two brushes for each phase. This makes a total of six brushes for the three rings, the brushes being mounted 180 deg. apart.

In Table I is given the cost of stripping 256,710 cu.yd. during the year of 1915. It will be noticed that the cost is 4.23c. per cu.yd. The writer has no figures available on the cost of stripping by means of locomotives and steam shovel, but feels assured that this figure will be far in excess of that secured by the method described in the foregoing paragraphs.

In Table II are given some figures covering the cost of stripping 56,565 cu.yd. during the month of October, 1915. It will be noticed that this cost is reduced to 4.19c. per cu.yd., there being considerable saving due to the absence of a blasting charge.

The control of this dragline excavator illustrates the tendency, on the part of mining operators, to adopt electrically driven machinery and thereby secure the advantages which it offers. The electric shovel is also finding its way into the mining field, one of these being used on the same stripping operation with the dragline described in this article. Frequently this equipment is operated day and night, stripping the dirt and rock from the coal beds and clearing the way for the shovels and locomotives that remove the coal to the breakers.



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Economical Generation of Thermal Power at Coal Mines—IV

By J. B. C. KERSHAW
91 Grosvenor Road, Colwyn Bay, Liverpool, England

SYNOPSIS—*The economical generation of steam requires an easy and exact control of boiler draft. This can be most easily accomplished by mechanical means. A boiler is designed as a vessel wherein steam is to be made; it is not a water purifier or heater. Best results are obtained when the feed water is raised to the boiler temperature before it enters the boiler proper.*

AN ADEQUATE supply of air has been shown (in Article III of this series) to be an essential requisite for good combustion. If this air can be preheated before entering the boiler furnace or the combustion chamber, the temperature attained and efficiency of the steam-raising process will be considerably increased.

The usual method of obtaining the necessary supply of air to the furnace and combustion chamber, in the past, has been that of relying upon the chimney which carries away the products of combustion. Chimney draft has, however, never been entirely satisfactory, even when aided by the use of steam jets; and in modern boiler plants either forced or induced draft apparatus is installed.

The assumption that chimney or natural draft costs nothing is quite fallacious, for not only is the capital outlay upon a chimney of 150 to 200 ft. high considerable, but its efficiency for producing draft depends upon the heat of the gases which pass up it. Thus to produce a suction equal to 1 in. on the water gage at the base of a chimney 150 ft. high, the temperature of the exit gases must be 600 deg. F., and below this limit the draft will fall off considerably. But with the exit gases at 600 deg. F., the heat lost will amount to between 17 and 33 per cent. of the fuel burned, according to the excess of air used for burning the fuel as measured by the CO_2 tests, the 33 per cent. loss corresponding to 6 per cent. CO_2 and the 17 per cent. loss to 12 per cent. CO_2 in the exit gases. The cost of chimney or natural draft with fuel at $2.50 per ton therefore varies from 43c. up to 83c. per ton of fuel consumed, over and above the interest and upkeep charges for the chimney.

Where new equipment is being installed, fan draft is in all cases the more economical and efficient; for not only can the fan be run at the speed best suited to the fuel being burned, but the draft can be altered according to the load on the boilers. With fans, also, the heat can be abstracted from the exit gases to the lowest possible limit without any fear of decreasing the draft, and the preheating of the air supply becomes a much more practicable and efficient proposition.

As regards the choice between the two systems of "forced" and "induced" draft, each method has its advantages, and the local conditions must be studied carefully in each case before deciding which to install. If the fan be placed behind the boilers at the foot of the chimney; that is, if the induced draft system be used, the heat losses by air leakage through the brickwork of the boilers and damper holes may be as high as with chimney draft, unless great care is taken to make the boiler and flue brickwork air-tight. For this reason, the "forced"-draft system is preferred by many engineers. In this case, if leakage occurs, the pressure is from within; and the smoke or flame that escapes from the crack calls attention to the loss at once.

As regards the draft required to burn ordinary lump coal or a well-screened slack, 0.33 in. on the water gage should be registered behind the bridge wall of the boiler furnace and 0.45 in. in the main flue behind the boiler, with either natural or induced draft. It is advisable to be able to increase these pulls to 0.50 and 0.70 in. respectively, when circumstances require it.

A fixed-draft gage, with the face dial marked in tenths of an inch, ought to be attached to every boiler furnace, so that the firemen may be able to judge of the pull on the furnaces and state of their fires without opening the furnace doors. Similar draft gages should also communicate with the main flues and the base of the chimney, in order that the engineer in charge may be kept informed as to the state of the draft on the whole steam-raising plant. With forced-draft apparatus the need for gages is just as urgent, but the places where they are installed must be altered to suit the system.

Advantages of the Fan-Draft

The following extract from a paper on "Fuel Economy," read by the writer in conjunction with W. H. Booth before the Institution of Electrical Engineers in London, summarizes the advantage of the fan-draft:

> Fan-draft must therefore be considered in the light of enabling an economy in chimney construction to be effected, and full use made of feed-heating apparatus. It is also useful as enabling boilers to be forced to rapid steam production, and presents itself as a safeguard against sudden load in lighting stations, and as a means of surmounting the load peak without excessive boiler plant. Fan-draft is thus useful as a means of reducing capital expenditure on chimneys and boilers, by promoting the rate of combustion of fuel at higher rates per unit of grate area. It enables the thickness of the fire to be regulated in better accordance with the fuel size and generally promotes elasticity. It is also useful in enabling the hot gases to be compelled to pass over all the heating surface, and baffles may be introduced that would otherwise be too great a hindrance. Its economy in other cases appears to demand the fullest practicable reduction of the calories in the exhaust gases by feed-water heaters, which in large stations may well be in two stages, and perhaps by air heaters for furnace supply.

The object of burning fuel under steam boilers is to produce "steam." The boiler itself, therefore, should be restricted as far as possible to this purpose, and

that the resistance is automatically cut into the rotor circuit when the motor is stalled. The maximum current taken by the motor under these conditions will not cause the circuit breakers to open. Thus the operator has control over the motor while it is stalled. This feature of stalling the motor and providing absolute protection makes it possible to obtain digging characteristics similar to those of a steam-actuated machine.

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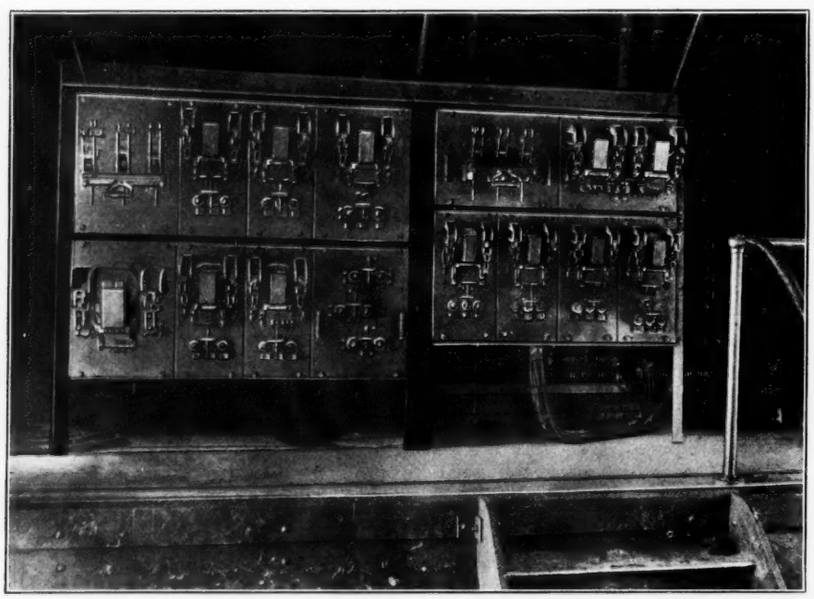

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91 Grosvenor Road, Colwyn Bay, Liverpool, England

SYNOPSIS—*The economical generation of steam requires an easy and exact control of boiler draft. This can be most easily accomplished by mechanical means. A boiler is designed as a vessel wherein steam is to be made; it is not a water purifier or heater. Best results are obtained when the feed water is raised to the boiler temperature before it enters the boiler proper.*

AN ADEQUATE supply of air has been shown (in Article III of this series) to be an essential requisite for good combustion. If this air can be preheated before entering the boiler furnace or the combustion chamber, the temperature attained and efficiency of the steam-raising process will be considerably increased.

The usual method of obtaining the necessary supply of air to the furnace and combustion chamber, in the past, has been that of relying upon the chimney which carries away the products of combustion. Chimney draft has, however, never been entirely satisfactory, even when aided by the use of steam jets; and in modern boiler plants either forced or induced draft apparatus is installed.

The assumption that chimney or natural draft costs nothing is quite fallacious, for not only is the capital outlay upon a chimney of 150 to 200 ft. high considerable, but its efficiency for producing draft depends upon the heat of the gases which pass up it. Thus to produce a suction equal to 1 in. on the water gage at the base of a chimney 150 ft. high, the temperature of the exit gases must be 600 deg. F., and below this limit the draft will fall off considerably. But with the exit gases at 600 deg. F., the heat lost will amount to between 17 and 33 per cent. of the fuel burned, according to the excess of air used for burning the fuel as measured by the CO_2 tests, the 33 per cent. loss corresponding to 6 per cent. CO_2 and the 17 per cent. loss to 12 per cent. CO_2 in the exit gases. The cost of chimney or natural draft with fuel at $2.50 per ton therefore varies from 43c. up to 83c. per ton of fuel consumed, over and above the interest and upkeep charges for the chimney.

Where new equipment is being installed, fan draft is in all cases the more economical and efficient; for not only can the fan be run at the speed best suited to the fuel being burned, but the draft can be altered according to the load on the boilers. With fans, also, the heat can be abstracted from the exit gases to the lowest possible limit without any fear of decreasing the draft, and the preheating of the air supply becomes a much more practicable and efficient proposition.

As regards the choice between the two systems of "forced" and "induced" draft, each method has its advantages, and the local conditions must be studied carefully in each case before deciding which to install. If the fan be placed behind the boilers at the foot of the chimney; that is, if the induced draft system be used, the heat losses by air leakage through the brickwork of the boilers and damper holes may be as high as with chimney draft, unless great care is taken to make the boiler and flue brickwork air-tight. For this reason, the "forced"-draft system is preferred by many engineers. In this case, if leakage occurs, the pressure is from within; and the smoke or flame that escapes from the crack calls attention to the loss at once.

As regards the draft required to burn ordinary lump coal or a well-screened slack, 0.33 in. on the water gage should be registered behind the bridge wall of the boiler furnace and 0.45 in. in the main flue behind the boiler, with either natural or induced draft. It is advisable to be able to increase these pulls to 0.50 and 0.70 in. respectively, when circumstances require it.

A fixed-draft gage, with the face dial marked in tenths of an inch, ought to be attached to every boiler furnace, so that the firemen may be able to judge of the pull on the furnaces and state of their fires without opening the furnace doors. Similar draft gages should also communicate with the main flues and the base of the chimney, in order that the engineer in charge may be kept informed as to the state of the draft on the whole steam-raising plant. With forced-draft apparatus the need for gages is just as urgent, but the places where they are installed must be altered to suit the system.

Advantages of the Fan-Draft

The following extract from a paper on "Fuel Economy," read by the writer in conjunction with W. H. Booth before the Institution of Electrical Engineers in London, summarizes the advantage of the fan-draft:

> Fan-draft must therefore be considered in the light of enabling an economy in chimney construction to be effected, and full use made of feed-heating apparatus. It is also useful as enabling boilers to be forced to rapid steam production, and presents itself as a safeguard against sudden load in lighting stations, and as a means of surmounting the load peak without excessive boiler plant. Fan-draft is thus useful as a means of reducing capital expenditure on chimneys and boilers, by promoting the rate of combustion of fuel at higher rates per unit of grate area. It enables the thickness of the fire to be regulated in better accordance with the fuel size and generally promotes elasticity. It is also useful in enabling the hot gases to be compelled to pass over all the heating surface, and baffles may be introduced that would otherwise be too great a hindrance. Its economy in other cases appears to demand the fullest practicable reduction of the calories in the exhaust gases by feed-water heaters, which in large stations may well be in two stages, and perhaps by air heaters for furnace supply.

The object of burning fuel under steam boilers is to produce "steam." The boiler itself, therefore, should be restricted as far as possible to this purpose, and

should not be used for purifying the water, or for preheating the water up to boiling temperature, both of which operations can be more efficiently carried out in other and specially designed forms of apparatus.

Fig. 1 shows, in the form of a diagram, the heat units absorbed in raising 1 lb. of solid steel and 1 lb.

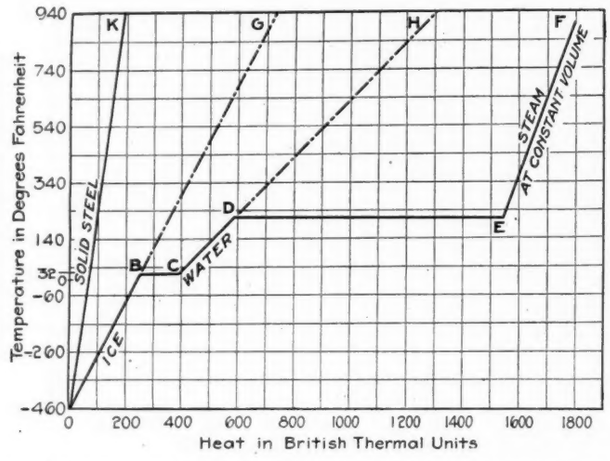


FIG. 1. DIAGRAM ILLUSTRATING HEAT TRANSFER TO WATER AND STEAM

of water respectively, from the absolute zero of temperature (—273 deg. C or —460 deg. F.) up to 940 deg. F. At 212 deg. F. a great absorption of heat occurs in the case of water, without any corresponding rise in temperature; and it is the great absorption of heat at this point which renders steam-raising different from many other processes of heat transfer. The vertical scale of the diagram represents the temperature in degrees Fahrenheit, while the horizontal scale represents the heat absorbed in British thermal units.

In the case of steel the heat absorption is indicated by a straight and continuous line (*AK*) and less than 200 heat units are required to raise the temperature from the absolute zero up to 940 deg. F. The heat absorption curve for water, on the other hand, shows that nearly as many heat units are required to raise it from the melting point of ice up to its boiling point (indicated by the line *CD*) and that at this temperature there is the disappearance of 966 heat units (indicated by the horizontal line *DE*) before any further increase in temperature occurs. These heat units in fact represent the energy required to convert the 1 lb. of water at 212 deg. F. into 1 lb. of steam at 212 deg. F., and are called the "latent heat" of steam.

From this point onward the temperature of the steam increases faster than that of the water for a given number of heat units, since 250 B.t.u. suffice to raise 1 lb. of steam from 212 deg. F. to 940 deg. F. (see line *EF* in diagram). The dotted lines *BG* and *DH* show the direction the heat absorption lines would have taken, had there been no internal molecular work required when the ice changed into water, and the water into steam, at the points *B* and *D* respectively, in the temperature curve of the diagram.

The lesson of this diagram is that 1300 B.t.u. are required to change 1 lb. of ice at 32 deg. F. into steam at 600 deg. F., or more than six times that required to raise 1 lb. of solid steel to the same temperature, and that had there been no change of state in the case of ice and water, this amount of heat would have produced a final temperature of over 2600 deg. F.

Conversely, the heat absorption of the water at this temperature, 212 deg. F., is exceptionally great, and the rate of the transfer of heat through the boiler plates is at its maximum.

In order to obtain the highest efficiency from steam boilers, therefore—that is, the greatest rate of heat transfer—the boilers should be fed with water at or near the boiling point, and the preliminary heating of this water should take place in accessory apparatus, such as feed-water heaters and economizers, using low temperature and other forms of waste heat which are inapplicable for steam-raising purposes.

Working under these conditions, with clean boiler plates, there is a wide margin for obtaining much higher evaporative results from steam boilers than are at present customary, without any loss of efficiency; since the danger of overheating the plates or tubes under these conditions of work is almost negligible.

The following extract from Bulletin 18 of the Bureau of Mines ("The Transmission of Heat Into Steam Boilers," by Henry Kreisinger and W. T. Ray) proves that this opinion is supported by the most advanced scientific workers on this subject in the United States:

> The results of the investigations described in this report indicate that the conductivity of the heating plates of steam boilers is so high that the present steaming capacities can be tripled or quadrupled by forcing over the heating surfaces three or four times the weight of gases now passed over them. With well-designed mechanical-draft apparatus this greater weight of gases can be forced through the boilers at a small operating cost. It is possible to increase the capacity of many of the present boilers in this way without reducing their efficiency much; in fact, by a proper arrangement of the heating surfaces the efficiency can be made higher than the present rating. The efficiency of any boiler can be increased by arranging its heating surfaces in series with respect to the path of hot gases. New boilers of high efficiency can be constructed by making the cross-section of the gas passages small, in comparison with the length.

Finally, the steam produced by the boiler should be superheated, in order to minimize the heat losses due to radiation during its passage through the steam pipes to the point where it is used, and also to insure that dry steam arrives in the engine cylinder or turbine drum, rather than a kind of Scotch mist, which too often has to do duty for steam in colliery plants.

Limits of space in this article will not permit the various types of feed-water heaters and economizers or superheaters to be discussed; but no up-to-date steam-raising plant can afford to be without these essential accessories to economical steam production, and at some later date I hope to return to this subject and deal with it more fully.

To summarize, however, what has been said; the production of steam from water should be carried out in several stages, beginning with the raising of the temperature of the purified feed water to 100 deg. F. by aid of exhaust steam. This warm water is then passed through one or more series of economizer tubes worked on the counter-current principle, and heated by the waste gases from the boiler. If still below the boiler temperature, the last degrees of heat are added, either by the use of live steam or by passing the feed water through the control apparatus which protects the superheaters from the direct heat of the furnace. The water

then enters the boiler at the critical temperature, and is at once ready for the absorption of the latent heat which converts it into steam.

The waste gases passing away from the boiler plant carry with them a large proportion (from one-fourth to one-third) of the heat of the original fuel, and if high efficiencies are to be attained for the whole power plant, it is imperative that the heat losses with these gases should be reduced to a minimum.

This reduction can be attained in three directions: (1) By cutting down the volume of the waste gases—that is, by working with a minimum excess of air. (2) By reducing the temperature of the gases by a skillful use of economizers and other forms of low-temperature heat-abstraction apparatus. (3) By substituting artificial for natural draft, and thus obviating the necessity of passing hot gases into the chimney shaft.

As regards the total amount of the heat losses through the exhaust steam and waste gases in a modern power plant, Fig. 2 is a diagram showing the whole of these losses. The large proportion of the heat which passes away in the waste gases and in the exhaust steam is at once apparent. In the case illustrated in Fig. 2, only 14.4 per cent. of the original heat value of the fuel is represented in the effective horsepower of the engines, over 80 per cent. of the heat energy of the fuel having been lost with the waste gases from the boilers and with the exhaust steam. As already stated, the heat of the exhaust steam can be most satisfactorily recovered by using it for the preliminary heating of the feed water for the boilers, and with a

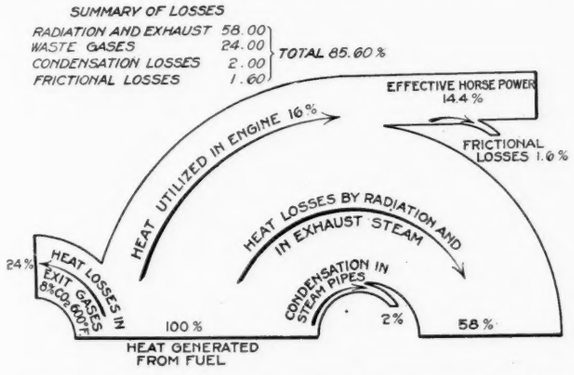


FIG. 2. HEAT EFFICIENCY DIAGRAM FOR STEAM BOILER AND ENGINE

well-planned and managed apparatus over 90 per cent. of this heat can be reclaimed.

The problem of the recovery of the heat of the waste gases is not so simple, since it is not possible, owing to the impurities which they carry, to abstract their heat by direct contact with the water intended for the feed. The usual plan is to abstract the heat by the aid of economizers—that is, a series of pipes placed in a special chamber at the rear of the boilers, through which the gases pass on their way to the chimney. As usually operated, the economizer system is capable of much improvement. Not only is the counter-current system of operating the flow of water and hot gases usually ignored, but the economizer tubes are not kept sufficiently clean, either outside or inside, to yield their highest efficiency. The number of tubes also is never sufficiently great to abstract all the heat of the gases, for the temperature at which the gases are allowed to escape to the chimney is usually between 550 and 650 deg. F., whereas with better equipment and management this might be reduced to 250 deg. F. Below this point the moisture contained in the gases would condense on the economizer pipes and would cause trouble owing to its acid constituents. But in time it is possible that even this difficulty will be surmounted, and that the whole of the heat contained in the exit gases from the boilers may be utilized.

Table I shows how rapidly the heat losses in the waste gases increase with their dilution, for while at

TABLE I. PERCENTAGES OF FUEL WASTED BY HEAT CARRIED AWAY BY EXIT GASES, AT VARIOUS TEMPERATURES AND PERCENTAGES OF CO_2

	Percentages of CO_2					
Temperature, Deg. F.	4%	6%	8%	10%	12%	14%
400	32.4	21.8	16.4	13.4	11.4	9.8
500	40.5	27.3	20.8	16.8	14.2	12.3
600	48.6	32.8	24.9	20.2	17.1	14.8

Adapted from "Smoke Prevention and Fuel Economy," by Booth and Kershaw.

12 per cent. CO_2 and 600 deg. F. the loss is 17.1 per cent., at 8 per cent. CO_2 and the same temperature the loss is 25 per cent.; and at 5 per cent. CO_2, 39.3 per cent. of the total fuel used is lost.

Turning now to the consideration of the customary methods of controlling the heat losses of the waste gases, temperature and chemical tests ought to be carried out regularly by the engineer or chemist in charge of the steam-raising plant. Even when automatic apparatus has been installed, it is still necessary to put a thoroughly skilled and well-qualified man in charge if the best results are to be obtained.

Limits of space will not allow a description in this article of the various forms of apparatus now on the market in the United States for checking and controlling boiler-house work, but a few general hints may be given upon their methods of use.

The temperature of the waste gases ought to be noted and recorded at frequent intervals—(1) at the exit from each boiler into the main flue, (2) at the inlet and exit of the economizers and (3) at the base of the chimney. Permanent and fixed thermometers may be placed at these points, or holes may be provided with 30-in. lengths of $1\frac{3}{4}$-in. wrought-iron pipe, the flanged top of which is kept closed with a tight-fitting wooden plug when it is not being used for making a test. Mercury thermometers filled with nitrogen are reliable for temperatures up to 1000 deg. F., but they must be mounted in a suitable carrier and must be left in the path of the flue gases long enough to attain the gas temperature—that is, 5 or 10 min., according to the thickness of the metal case surrounding the thermometer bulb.

The only point where the temperature of the gases may exceed the limit named above, as measurable by a mercury thermometer, is at the exit from each boiler into the main flue. But if the temperature here registers over 900 deg. F., it means that the boiler is dirty and badly scaled, and the sooner it is put out of use the better for the efficiency of the plant. The following are the temperatures which should be maintained in a well-managed plant: Temperature at exit from boilers into main flue, 650 deg. F.; temperature at exit from economizers, 350 deg. F.; temperature at base of chimney, 300 deg. F.

As already stated, with forced or induced draft the temperature of the gases that issue from the economizers may be reduced to the point at which condensation of the moisture commences to occur.

As regards the chemical tests which are necessary to determine the excess air and air-leakage of the boilers, it is obvious that only when these are made regularly and the records are studied by some competent person, can exact knowledge be obtained of the efficiency or otherwise of the firemen and furnaces. The waste gases contain carbon dioxide, moisture, nitrogen and unconsumed oxygen as regular constituents; and the percentages of carbon dioxide and oxygen respectively are the figures which enable one to say with what excess of air the combustion process is being maintained.

Excess of Air Necessary for Good Combustion

If it were possible to obtain good combustion of bituminous coal with the theoretical amount of air, the exit gases would contain 19½ to 19 per cent. of CO_2 and no free oxygen, and 12 lb. of dry air would be required to burn 1 lb. of coal. Since it is impossible to obtain good combustion of solid fuel with only the theoretical amount of air passing through the furnace, an excess of air is necessary, but the amount of this excess should not exceed 50 to 75 per cent. (corresponding to 12.6 and 10.9 per cent. of CO_2 respectively).

Tests showing percentages of CO_2 below the latter figure indicate that much more air is being passed through the furnaces than is required, and since all this air has to be raised to the combustion temperature, say 2500 deg. F., and carries off some portion of heat to the chimney, it is evident that the smaller the excess supply may be kept the better.

A CO_2 test showing 10 to 13 per cent. is therefore the best for obtaining high efficiency from the boilers. Above 13 per cent. of CO_2 there is grave danger of allowing carbon monoxide and hydrocarbon gases to escape unconsumed with the exit gases, and it is unwise to attempt to reduce the excess of air below the 50 per cent. margin represented by 12.9 per cent. CO_2. Where attempts are being made, however, to reach a still higher efficiency, it is necessary to test the exit gases regularly for carbon monoxide and for methane, as well as for carbon dioxide and oxygen, and this demands a more complicated form of gas-testing apparatus.

Composition of Exit Gases

In a future article I hope to return to this subject, and to give a full description of the gas-testing apparatus and methods of control best adapted for colliery use. Here, I can only indicate one short-cut method of arriving roughly at the composition of the exit gases.

Air contains 79 per cent. nitrogen and 20.8 per cent. oxygen, by volume. When burning a bituminous fuel of average quality, yielding 35 per cent. volatile matter on heating, about 1.8 per cent. of the oxygen of the air will be required to complete the combustion of the hydrogen contained in the coal, and therefore the air that remains will contain only 19 per cent. of free oxygen.

The tests for carbon dioxide and for oxygen when added together ought therefore to total 19 per cent.; and if there is a continued deficiency in the tests when dealt with in this manner, it indicates that carbon monoxide or hydrocarbon gases are also present in the exit gases. When burning coke or anthracite fuels which contain only a small percentage of hydrogen and volatile hydrocarbons, this disappearance of oxygen does not occur. The CO_2 and oxygen tests of the waste gases, in such cases, when added together should equal the original oxygen content of the air, namely 20.8 per cent.

In concluding this series of articles upon heat economy in coal-mining power plants, I must once again emphasize the fact that scientific management and control are necessary to obtain the highest efficiencies from steam boilers. It is useless to install complicated automatic apparatus in the boiler house, unless one is willing to provide skilled and properly trained men to take charge of it. In support of the view that there is plenty of work in the boiler house for the chemical engineer, the following extracts from a recent article by Joseph G. Worker, which were printed in an American journal,[1] may be quoted:

> Mechanical stoker equipment is not, and never can be, a substitute for intelligence and good judgment, and there are just as good reasons for intelligence in handling stoker-fired plants as in hand-fired plants. . . .
>
> A few years ago, a large plant in Chicago was using 7½ lb. of coal per kilowatt-hour, and at present it is using 2⅞ lb. of coal per kilowatt-hour, with the same kind of fuel. In 14 years this engineering progress in turbine, boiler and stoker equipment and methods of operation has been equivalent to a saving in one year of approximately 2½ million tons, or 58,000 carloads of coal. . . .
>
> When the statement is made, therefore, that the savings in a power-station must be made in the boiler room, this refers to operation and management and not to the design of the equipment used.
>
> Conditions in boiler-plants show that the operators must be trained in the combustion of fuel. The operation of boilers and stokers must be approached along more scientific lines. It is only necessary to examine the conditions of the plants in this country where coal is fired, in order to realize what is needed and how much it is needed. . . .
>
> Suitable instruments should be used for furnace operation, but with their installation should go training in their use. Too many instruments are now installed and inoperative, because the men in the boiler room have shown no real grasp of the subject of fuel combustion, nor do they know how to use the information indicated by them.

In Lighter Vein

Familiar Trait of the Mining Mule

W. B. Goldsmith, who is chief engineer of the South East Coal Co.'s plant at Seco, Ky., vouches for the truth of the following story. He relates that in the mines of the company there was a "balky," slow-going mule that the driver always put in front of an animal that moved along at a thoroughly satisfactory pace. On occasions when it became necessary to "back," says Mr. Goldsmith, this second mule would invariably grab the "balky" slow-going one with his teeth and pull him back, a feat which sometimes required the animal's whole energy and strength. The whole working force of the company are proud of the mule and would not part with him at any price.

[1] Electrical Review, Sept. 22, 1917.

Deflection Angles and Azimuth

BY MINING ENGINEER
Scottdale, Penn.

HAVING visited the engineering departments of many small coal-mining companies, I was surprised to find that more than 75 per cent. of them were using the system of deflection angles in their surveys instead of the continuous vernier or azimuth. I will admit that deflection angles are more suitable for city engineering and railroad work, but for surveys in connection with mining engineering such as stream and outcrop location, topography and the establishment of the hundreds of stations on which the mine maps are based, it cannot help but be evident to anyone acquainted with the azimuth system that deflection angles are not nearly so efficient as azimuth.

I inquired at every office as to why they preferred to use deflection angles and was given the following two reasons: First, the astonishing fact that they were not familiar with azimuth and did not know its advantages; second, that those acquainted with azimuth and who realized its usefulness were afraid of changing their system for fear of causing confusion in their records.

In this article I will try to show just how much work such a change will involve, and also give a comparison of the two systems, azimuth and deflection angles. In using the azimuth system, it is necessary to have a transit graduated as in the accompanying sketch; all angles are to be measured to the right of zero, which should be north. At each set-up the transit circle is clamped in such a position that zero on it points to north and each reading of the vernier reads an azimuth angle measured to the right of zero, or north. Therefore, an angle of 40 deg. equals N 40 deg. E; 80 deg. equals N 80 deg. E; 170 deg. equals S 10 deg. E; 190 deg. equals S 10 deg. W, and the azimuth is recorded in the notebook.

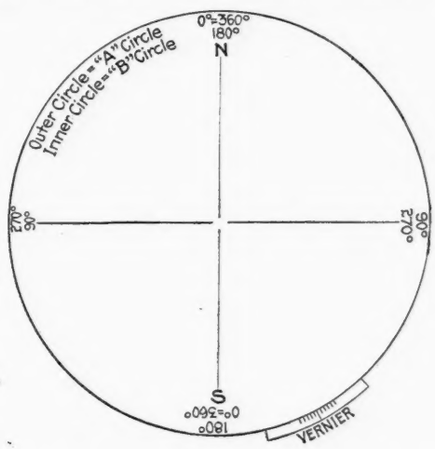
In making a survey the transit is leveled up, and when the backsight has been taken, zero on the instrument must always point to north; this is accomplished (the old notes showing the stations already established) in the following manner:

Station	Azimuth	Vert. Angle	Distance
149-150	86 deg.	0 deg. 00 min.	258.7

Stationed on 150, and before backsighting on 149, set the vernier on 86 deg. (the old azimuth from 149-150) + 180 deg. on account of looking in an opposite direction from what the old notes record; or another way is to set on 86 deg. on the *A* circle and when foresighting read the *B* circle, so that after the backsight has been taken, it is evident that zero on the transit circle is pointing to north, and any angle read to the right of zero will be the azimuth to the point being located. The azimuth for dozens of shots can be read because the transit circle is clamped in a position that makes zero point to north, and when changing the sight from one object to another the transit plate does not move from the position in which it is clamped, only the vernier moves.

When notes are sent in to the office the course is plotted with ease, as it can be seen by inspection that the course corresponds to the azimuth. There is absolutely no calculation necessary to plot the courses, which is certainly not the case with deflection angles. When the transitman makes a tie between two surveys he can compare his new azimuth with the old azimuth and see at a glance the closeness of the tie, without tracing back a lot of angles and then wondering if he has made an error in adding or subtracting.

In many mines headings are driven on a general course, but a heading is not always driven exactly on that line, and the survey will frequently vary from the projected course. If a line has been run up the haulage heading with deflection angles and the same method is used in the air-course or parallel heading, it is a job requiring accurate though not difficult figuring to know if the headings are driven parallel or not; and I can vouch right now that mistakes are plentiful. Whereas, if the survey is run on azimuth, the transit does all



HOW THE TRANSIT SHOULD BE GRADUATED

the figuring; and if the last azimuth in the haulage heading was 69 deg. and in the air course 69 deg., it is evident at once that the headings are parallel; and it is also evident that the course is north 69 deg. east in case the course is desired.

A good example of the roundabout calculations used in deflection angle work is given in the following illustration: The draftsman, in projecting some new work, decides that a new heading should be driven from a certain point to another fixed point; he takes the coördinate values and figures a course; in setting the sights, the transitman figures the deflection angle he must turn from the course; and finally in plotting the transit notes, the draftsman figures the course on which to plot the notes from the deflection turned by the transitman. The draftsman knew the course originally, and yet before he finally plots the notes it is necessary for both transitman and draftsman to transpose from course to deflection angle and vice versa; and I cannot see the necessity or advantage of a different system for the office than for the field work, and certainly most all office work is expressed in terms of courses. With the azimuth system, only one calculation is necessary to transpose from azimuth to course, and that calculation

is so simple an addition or subtraction that it is usually done mentally and can hardly be called a calculation.

In regard to changing the system, I think it safest to start in with some surface surveying, as it is much easier to break in a transitman to a new system if he is unhampered by the difficulties met with in underground work. For a short time continue to run surveys with deflections, but in addition, after having noted the deflection to the foresight, take a new backsight with the vernier set on the azimuth to that point, and then after sighting on the foresight read the azimuth to that point also. This will give the transitman a clearer understanding of azimuth than any written description will do.

After the transitman has a thorough understanding of the system, pick out some circuits that make close angle ties and write the azimuth from station to station in the notebooks. This can be done without disturbing the old notes in any manner, and if a dozen circuits are prepared in this manner in the different sections of the mine and on the surface, it becomes merely a matter of time until the whole field is in the same shape. The change in system will have been so gradual that I am sure there will be no confusion of records; and I am equally sure the results will be worth the effort.

The Storage Battery

BY ELECTRICAL ENGINEER

Storage batteries are sometimes called secondary batteries. This is a term used to identify them from the ordinary type, which is called a primary battery. A secondary battery is one that is used as an accumulator or container wherein to store up electricity; it has to be charged with electric current before it is of any use. A primary battery is one that makes and delivers its own current, by the action of chemicals on plates of metal or other substances.

In the making and operating of the lead-acid type of storage battery, the positive plates are made of red lead mixed into a paste with sulphuric acid and pressed into lead grids, or frames. The negative plates are made up of metallic lead ground into a powder and mixed into a paste with sulphuric acid, and then pressed into a similar frame. The plates are then assembled into batteries, using wood and rubber separators to keep them insulated from each other. The battery is then filled with sulphuric acid and allowed to stand for 10 or 12 hours before being placed on charge. This gives a chance for all the sulphate in the acid to be absorbed by the plates, and if a hydrometer reading of the electrolyte were taken at this time, it would indicate water.

The batteries are then put on charge, one terminal being connected to the + or positive group, the other to the — or negative. The current is run through the battery, relying on the water or acid for a conductor to complete the circuit. As the current flows through the sulphate gradually comes out of the plates into the water, converting it into sulphuric acid. A battery is never fully charged until all the acid has been removed from the plates.

When the battery is put into use, a reverse action takes place, the sulphate leaving the water and going back into the plates until the battery is fully discharged.

A storage battery must be charged with direct current; never use alternating current for this purpose, as it will ruin the battery. If alternating current only is available, it will be necessary to provide apparatus for converting it into direct current. Several forms of apparatus are on the market for this purpose, either motor generators or rectifiers. Always connect the positive terminal of the battery to the positive wire of the charging current and the negative battery terminal to the negative wire of the circuit.

The charging rate of a storage battery varies with the different types. A current in excess of the regular rate, or too long a charge, will cause the plates to buckle and the cells to sulphate. It is important that a lead-acid type of battery have the best of care and attention. A battery charge is usually complete when, with charging current flowing at the normal rate, all cells are gassing (bubbling) freely and evenly, and the specific gravity and voltage of all cells have reached a maximum—that is, have shown no further rise during a period of 5 hours.

Once every week, or as often as may be found necessary, remove the filling plugs from the cells and add pure water until the level of the electrolyte rises to the proper height. It is necessary at all times to keep the plates and separators covered with electrolyte; water should be added to the cells before or during the early stages of a charge, as the electrolyte will then become mixed by the gassing, so that correct hydrometer readings can be taken and any danger from freezing in cold weather is avoided, as thoroughly mixed electrolyte will not freeze solid.

SELDOM NECESSARY TO ADD ELECTROLYTE

As only water evaporates from the electrolyte, there being no loss of acid, it is never necessary during normal service to add acid or electrolyte to a battery. If, however, a battery is upset and acid spilled, or if a jar is cracked and electrolyte leaks out, it should be replaced with electrolyte of the proper specific gravity. Positive plates in all types of batteries are usually dark brown in color; negative plates are usually gray in color. Separators usually consist of specially treated flat wooden veneers which are placed between adjacent plates of the element.

The fluid, or solution, in the cells, called the "electrolyte," is a mixture of pure sulphuric acid (oil of vitriol) of approximately 1.84 specific gravity and pure water. The specific gravity of the electrolyte in the average battery when fully charged should be between 1.250 and 1.280 at a temperature of approximately 70 deg. F. Decreasing specific gravity throughout the battery (when not due to insufficient charging) indicates that sediment is accumulating in the bottom of the jars. An inspection should be made when the specific gravity of the fully charged battery remains low.

Change in temperature of electrolyte affects the specific gravity, and where the change is considerable it should be allowed for when taking readings, as follows: For each 3 deg. in temperature above 70 deg. F. add one point to the hydrometer reading, and for each 3 deg. of temperature below 70 deg. F., subtract one point. Acid is usually furnished of 1.835 or 1.84

specific gravity, and may be broken down to a lower gravity by mixing with pure water. When mixing, always pour the acid into the water; and if it becomes warm allow it to cool before using.

The ampere-hour capacity of a battery, the cells of which are connected in one series, is the same as that of a single cell in the series. The ampere capacity of a cell depends upon the number of plates of a given type. The ampere-hour capacity of a plate depends upon the amount of available active material it contains.

Since acid and lead combine with each other in a definite proportion in producing current, it might seem possible to have acid and lead in a cell in such quantities that both would be completely exhausted. Toward the end of the discharge, however, the electrolyte would be so weak that it would not be capable of producing current at a sufficient rate for any practical purpose. For this reason, it is necessary to have electrolyte acid in excess of the amount actually used in the plates during discharge. Similarly, if all the active material were combined with acid, the plates would lose their porosity and conductivity, and an excess of active lead material is likewise provided. It is customary to make both outside plates in a cell negative. The cell contains, therefore, an odd number of plates and the capacity is fixed by the number of positives.

Batteries Should Be Carefully Charged

Since the current is produced by the action of sulphuric acid on the lead in the plates, the rate at which the acid can get to this material determines the maximum rate at which current can be produced. During any discharge of a battery, there is being formed sulphate of lead, without which there would be no production of current. If, however, charging is neglected, the sulphate reaches a condition which tends to fill the pores of the plates and make the active material dense and hard. It is this condition which is ordinarily referred to as "sulphated." The cause of this condition is some form of abuse, such as standing discharged for some length of time, habitual undercharging, neglecting evidence of trouble in individual cells, replacing evaporation with electrolyte, thereby restoring specific gravity by adding acid to the cell instead of bringing it out of the plates by proper charging. The lead sulphate formed in a normal discharge of a battery is in a form in which it absorbs the charge readily.

When a battery is sulphated, the sulphate is in a condition to absorb the charge with difficulty and the ordinary charge is insufficient. Continued and persistent charging at a low rate will restore any condition of sulphate, the time being in proportion to the degree to which the condition has been allowed to extend. It is a question of time; since a high rate will only produce gassing and high temperature, the low rate is all that a battery in this condition is capable of using.

A battery is sulphated only when acid is tied up in the plates. When the specific gravity of the electrolyte has reached a maximum, it shows that there is no more sulphate to be acted upon, since during charging the electrolyte receives acid from no other source. Hydrometer readings should therefore be taken at regular intervals during charging to determine if the specific gravity is rising or if it has reached its maximum. The charging should be continued until there has been no further rise in any cell during a period of 12 hours. The active material of sulphated negative plates is generally of light color, and either hard and dense or granular and gritty and easily disintegrated. It is the negative plates which require the prolonged charge necessary to restore a sulphated battery. Sulphated positives, unless physically disintegrated or badly buckled, are but little changed in general appearance and can be restored to operative condition, although their life will not be as great as if they had not been subjected to this abuse.

Sulphated plates should be handled as little as possible. Mining is rough, hard work, and mining apparatus must be exceptionally strong and rugged to stand the strain. Especially is this true of the storage batteries.

The Edison nickel-iron-alkaline storage battery consists of a combination of iron and nickel elements in a nonacid electrolyte. The characteristics of this battery are different from those of the lead-acid type. The elements—nickel hydrate and iron oxide—in an alkaline solution, are contained in a nickel-plated steel container. The gases evolved from this cell on charging do not carry with them any noxious fumes. No injury is done this cell by an overcharge nor if it is accidentally charged backward. It must be charged in the proper direction, however, to render service. Specific gravity readings on the electrolyte are not necessary. Many of the troubles encountered with the lead-acid type of battery are eliminated in the Edison battery. If the electrolyte is emptied out and replaced with new every nine or ten months, satisfactory operation may be anticipated.

Ventilate the battery room or compartment and never bring a flame or spark near the battery when charging. Always be careful, orderly and clean; never undercharge the batteries or try to hurry up the charge by an excess of current. Give the batteries proper and careful attention, and the reward will be satisfactory service and long life.

Lake Coal Receipts at Milwaukee

The following figures show the coal movement to Milwaukee by Lake during 1917 compared with that of the previous year:

Month	Anthracite		Bituminous	
	1917 Tons	1916 Tons	1917 Tons	1916 Tons
January	3,861	10,636	26,037	16,052
February	8,992	24,814	18,847	21,027
March	11,369	24,550	19,394	21,094
April	32,134	74,946	148,753	184,348
May	63,553	78,115	372,463	610,617
June	87,273	70,278	386,510	480,685
July	106,817	138,678	507,671	539,462
August	150,938	157,684	462,156	669,077
September	135,571	71,669	392,660	476,983
October	190,847	90,386	427,101	408,722
November	149,586	132,621	301,736	284,119
December	38,935	71,178	131,978	288,698
Total	979,876	945,555	3,195,306	4,000,884

These figures are from the books of the custom house and include coal which arrived on carferries from across Lake Michigan. This accounts for the winter receipts by lake. Carferry receipts should logically be classed as rail receipts. About 10 per cent. of their volume remains in Milwaukee. The rest goes through to the interior. In 1916, carferries brought 97,256 tons of hard coal and 262,568 of soft coal. Last year the record shows 64,047 tons of hard and 174,144 tons of soft coal.

Coal—Its Origin and Composition

By H. B. MILLER
Pittsburgh, Penn.

SYNOPSIS—*This article answers the oft-repeated questions: What is coal? How was it formed? How is the presence of partings, binders, sulphur, etc., accounted for? The various stages in the formation of coal from vegetable matter to its present form, and the conditions favoring development, are noted. The "earmarks" of coal beds are explained; the substances composing coal analyzed. The heat units spoken of in connection with coal are defined; and the method of determining the calorific or heating value of coal enlarged upon.*

IT IS generally conceded by geologists that coals of the various beds represent in varying stages of preservation accumulations of vegetable matter, also a small proportion of the remains of animal life; and that coal is transformed peat, which formation took place from plant remains in vast lowland or coastal swamps and deltas, and on a nearly horizontal surface at or near sea or lake level. During this formation there was an abundance and luxuriance of the vegetation, such as fern-like plants, numerous climbing ferns, as well as the number and size of lepidophytes and calamites.

The characteristics of climates during the coal-forming period were mildness of temperature, and in most cases tropical or subtropical; also during this time there was a uniformity of climatic conditions, high humidity and abundance of rainfall. This accounts for the great luxuriance in growth of plants and their much greater annual contributions of refuse delivered over the peat-forming area.

Length of Time to Form One Foot of Peat

As to the amount of peat growth per year, it differs according to opinion. It can be assumed, however, that 1 ft. of peat can be formed under a bog in 10 years, which would be known as surface peat; but this would be further reduced when compacting would take place and under bacterial action furthering the decomposition of the underlying peat. So it is figured that the rate of formation is 1 ft. per century at a depth of about 18 ft., and that it takes 3 ft. of well-compacted old peat deeply buried to produce 1 ft. of bituminous coal having the character of the Pittsburgh bed of Pennsylvania, or 300 years to produce 1 ft. of coal, or 1800 years for 6 feet.

The formation of a thick bed of coal is therefore seen to indicate in general the maintenance for a long period of an approximate balance between the rate of peat accumulations and the rise of the water, so as to maintain a depth of water favorable for the growth of the vegetation and its preservation as peat.

The transformation of fresh vegetable matter into coal was accomplished by two different processes known as the "biochemical" and "dynamochemical." During the biochemical process, under somewhat varying and yet restricted conditions attending the formation of peat, the accumulating vegetable matter became more or less disintegrated or decomposed and reduced, and many of the organic chemical compounds of the original material were more or less broken down and changed in ways controlled by those conditions. Therefore, the residual product of the biochemical process was a peat, or its equivalent, according to its process or advanced stage.

The dynamochemical process covered the chemical and physical alterations of the coal-forming matter (peat) induced and controlled by geodynamic influences. The first physical expression is seen in the densification of the peat under the load of superincumbent strata, and in consolidation of the residual substances. In this way the fuel mass, much reduced in volume, assumed its more typical geologic relation as a stratified mineral sediment or bed of coal. The various grades of coal, such as anthracite, bituminous, sub-bituminous, cannel coal and lignite were thus formed, according to the conditions and various stages passed through.

The Interval between Coal Beds

The interval between coal beds and existing stratigraphy of the present day was caused by subsidence and the deposition of varying thickness as of other materials, such as clays, sands and calcareous muds, which became solidified, thus giving the rock and shale stratas. Following this there was a slight uplift of the region and consequent withdrawal of most of the water, so that the level of the subaqueous deposits was so near to the surface of the water cover as again to favor swamp conditions and the formation of another bed of coal. Therefore, coal has been derived from plant life, or rather its most resistant components which make up its residue, of which resin, resin waxes, waxes, and higher fats, or the derivatives of the compounds composing these, are the most important.

The presence of binder in coal is due to the variations of water level that took place attending its formation; the withdrawals of the water cover were temporary irregular reductions, seasonal or perhaps less frequent. These periods of reduction and evaporation appear generally to have been attended by concentration of the hydrocarbon solutes resulting from the putrefaction process in the form of paste, which now constitutes the jet-like "binder" of the coal, or its sheeting by fragments of "mineral charcoal" ("mother of coal").

As coal was formed at or nearly sea or lake level, it is indicated that the sea did probably in some cases break over the coal—formation swamp at times—and caused an intercolation of overwashed muds, silts or sands, which later became solidified, forming partings such as slate or rock bands.

The substances usually considered in the composition of coal are moisture, or water, volatile combustible matter, fixed carbon, sulphur and ash. The amount of moisture in coal is variable and depends upon its nature and physical condition. However, as a constituent it has no value and is dug, handled, hauled and expelled

at the cost of fuel. Every per cent. of moisture present, means 20 lb. less fuel for each ton of coal.

Volatile combustible matter is that portion which may be driven off in a gaseous state by heat and is an important constituent in determining the quality of coal. The variance of the per cent. of volatile matter in coal is due to the work of the dynamochemical process during its formation or the transformation of the fuel from the peat stage, or primary rank of coal, to the more advanced ranks of coal—that is, the progressive reduction of the volatile matter of the fuel, or the "devolatilization" or "carbonization" of the coal, caused by pressure, thrust, expulsion of water, escape of gases, and additional changes in the chemical constituents. Volatile matter consists principally of water in the coal plus a portion of the sulphur combined (say, about one-half the total sulphur in the coal), plus the nitrogen and hydrocarbons of unknown and varying compositions. Nitrogen and combined water in the volatile matter have no heating value. If present in large amounts, the heating value of the combustible will be correspondingly lower.

Fixed carbon is usually the principal combustible of coal, and as its name indicates is mostly carbon, derived from plant life and one of the organic compound elements that go to make up coal. With an increase of fixed carbon there is a decrease in volatile matter, and vice versa.

The presence of sulphur in coal can be attributed to the submergence of the coal-forming peat deposits during the early stages of coal formation, and the immediate occupation of the area by animal life and the action of sulphur bacteria. In some basins the high sulphur content is caused from the erosion that occurred of some of the richly sulphide-bearing rocks in the drainage of the basin. In some cases it also has been caused by secondary enrichment, the sulphur being brought probably as sulphates from overlying strata and anticlines, and deposited as sulphides in the basin by the decomposing agency of circulating ground waters.

Some Data on Sulphur in Coal

Sulphur usually occurs in coal in the form of iron pyrite (FeS_2) and is present either in scattered masses or partings, and sometimes in such a finely divided form that the separate particles are too small to be recognized. When sulphur is combined with carbon, or carbon and hydrogen, it is known as "organic" sulphur. Sometimes sulphur occurs in coal in the form of free sulphur, but the relative amount of this is small. Sulphur when burned will develop heat and is not an inert substance, like moisture and ash; but its occurrence in coal as pyrite, as is usual, is objectionable on account of its forming clinkers and having corrosive features. Sulphur in coal cannot be removed by washing if its presence is organic, but it can be removed to a fair extent if its presence is in flakes or lumps of appreciable size, providing the coal is crushed sufficiently to allow the separation of a large part of the pyrite from the surrounding coal.

It has been conceded that beds of coal represent accumulations of vegetable matter in varying stages of preservation and as a rule but a very small proportion of the remains of animal life. Mingled with the organic substances are different inorganic mineral sediments, which, together with the mineral matter originally contained in the plants themselves, constitute the "ash" of coal. The high ash content of a coal may be due to the precipitation of colloids by the overflow of alkaline waters and the deposition of silica in the organic mass of the coal.

The term "ash" as ordinarily used means the mineral residue left after complete combustion or burning of the coal. It is an inert constituent which means 20 lb. of weight to be handled and 20 lb. loss per ton of coal for each per cent. present. The color of the ash gives an idea of the amount of iron contained in the fuel. In a proximate analysis of coal the moisture, volatile matter, fixed carbon and ash should total 100 per cent.

The Calorific or Heating Value of Coal

The most accurate method of determining the total heating value of coal is by direct determination in the bomb calorimeter (dry basis). A calorie is the quantity of heat required to raise the temperature of one kilogram of water 1 deg. C. at or about 4 deg. C. A pound-calorie is the quantity of heat necessary to raise the temperature of 1 lb. of water 1 deg. C.

A British thermal unit (B.t.u.) is the quantity of heat required to raise the temperature of 1 lb. of water 1 deg. F. at or near the temperature of maximum density, 39.1 deg. F., or the amount of heat required to raise the temperature of 1 lb. of water from 63 to 64 deg. F.

The amount of heat obtained in the burning of 1 lb. of coal under theoretically perfect conditions is called the B.t.u. of the coal. Each heat unit represents 778 foot-pounds of energy, the mechanical equivalent of one unit.

$$1\ B.t.u. = 0.252\ calorie$$

$$1\ pound\text{-}calorie = \tfrac{9}{5}\ B.t.u. = 0.4536\ calorie$$

Before the bomb calorimeter came into use the heating value of coal was frequently calculated from the ultimate analysis by either of Dulong's formulas following:

Calorific value in pound-calories per pound:

$$8080C + 34{,}460\left(H - \frac{O}{8}\right) + 2250S \qquad (1)$$

Calorific value in B.t.u. per pound:

$$14{,}544C + 62{,}028\left(H - \frac{O}{8}\right) + 4050S \qquad (2)$$

The agreement between the calorific values calculated by Dulong's formula and those determined by the calorimeter are fairly close, with a probable error not exceeding 2 per cent. by Dulong's formula.

The combustion of the heat-producing constituents of coal yield essentially the heat produced by the oxidation of the carbon plus the heat produced by the oxidation of the hydrogen not combined with oxygen, plus the oxidation of unoxidized forms of sulphur and iron.

The fusibility of the ash is dependent upon the chemical and physical condition of the minerals present. When sulphur is present as pyrite it may produce, by being united with other constituents of the ash, a fusible compound or clinker. Generally the most readily fusible mixtures are those approximating a uni-silicate. Some silicates up to a tri-silicate composition are fusible at temperatures between 1000 and 1200 deg. C. (1800 to 2200 deg. F.). Ash from coals high in pyrite is necessarily high in iron, and the ratio between the

bases and silica is often such that easily fusible compounds may be formed.

Phosphorus occurs in coal and rocks of various kinds and ages. Its name is derived from the Greek words *phos*, "light," and *phoros*, "bearing." Its presence like sulphur in coal, in large amount, makes a coal of that kind objectionable for the manufacture of iron and for metallurgical purposes generally.

In conclusion, from the foregoing it can be judged that coal has originated from plants of various kinds ranging all the way from algae and fungi to large trees (and a very small proportion of animal life) which finally took the form of peat under the biochemical agencies during the peat stages and then underwent the action of the dynamochemical agencies during the coal stages. Coal is therefore considered transformed peat.

The proportion of the products of the composition of coal has already been described and accounted for, but it can be stated that the analysis of a coal does not necessarily determine its value or the use to which it can be put. However, by comparison of various analyses certain standards may be adopted showing in a general way for what purpose it is best suited.

EXAMPLES OF THE VALUE of anthracite lands in the early days may be of interest. In 1792 large areas of land were leased to the Lehigh Coal Mine Co. for two ears of corn a year. The State of Pennsylvania patented between 1795 and 1816 large areas for $2 to $4 an acre. In the period 1840-60 as much as $50 was received for this coal land, and in the late '70s the value had risen to $500 an acre, while at the present time $3000 an acre for virgin coal land is not dear.

Coal Exports from New York

During the year 1917 there was exported from the Port of New York 134,253 tons of anthracite coal, 14,348 tons of bituminous and 21,908 tons of coke. For the year 1916 the exports were 204,327 tons of anthracite, 42,302 of bituminous and 18,872 tons of coke; showing a decrease in the amount of anthracite exported in 1917 of 70,074 tons; 27,954 tons of bituminous and an increase of 3036 tons of coke. The exports by months, as compared with 1916 follow:

Month	Anthracite		Bituminous		Coke	
	1916	1917	1916	1917	1916	1917
January	8,921	7,934	893	2,049	136	1,660
February	8,740	4,981	1,245	1,731	817	1,211
March	8,231	13,720	2,193	3,224	2,177	505
April	19,257	8,339	2,229	171	1,677	1,325
May	17,809	16,714	4,419	995	1,331	1,900
June	20,949	14,693	5,108	1,939	966	3,650
July	19,489	15,967	4,387	448	1,897	3,434
August	40,671	3,942	6,025	967	1,195	1,763
September	6,800	26,988	1,012	593	2,447	2,909
October	36,235	3,288	8,427	43	2,521	1,531
November	7,751	10,856	1,934	1,229	1,957	304
December	9,474	6,831	4,430	959	1,751	1,716
Total	204,327	134,253	42,302	14,348	18,872	21,908

The reports show that of the anthracite exported from this port Canada received 98,402 tons; Newfoundland, 9445 tons; San Domingo, 11,738 tons; Brazil, 986 tons; while 1497 tons went to Chile.

Of the bituminous coal Brazil received 1999 tons; San Domingo, 755 tons; Canada, 30 tons; and Chile, 316 tons. Chile received 3475 tons of coke, Brazil 1115 tons and England 437 tons.

To France was sent during the 12 months 8571 tons of coke, 112 tons of anthracite and 54 tons of bituminous; while Italy received 200 tons of anthracite, 804 tons of coke and 125 tons of bituminous.

THE MINER

By Berton Braley

Greater than King or Potentate

GRIMY, and caked with dust of coal he stands,
Grasping his pick within his mighty hands;
The arbiter of destiny and fate,
Greater by far than king or potentate.

Shops may not run except at his behest,
At forge and blast his strength is manifest.
The rolls that rumble and the shears that scream
And all the million miracles of steam

Depend on him for fuel that will turn
The wheels that urge them and the belts that churn.
Guns that will shatter fortresses of steel,
Ships that will plow the waves on steady keel.

Holds the World in Thrall

BEARING munitions for an army's need
Must wait the miner's orders and take heed
That he who toils within the coal mine's murk
Gives them the coal with which they do their work.

Behind the men who battle in the trench
There stand the workmen at the lathe and bench,
But back of them and master of them all
The miner stands and holds the world in thrall.

Not soon again shall any man forget
How much the world is in the miner's debt,
For we shall read upon fame's honor roll
"He won the war—his labor gave us coal!"

[Men of the coal industry who find it necessary to get to the national capital on business these days are invited to avail themselves of the facilities afforded by the Washington Bureau of "Coal Age," which is centrally located in the Union Trust Building. The bureau is in charge of Paul Wooton, who is in a position to be of material assistance to those who have business to transact with Government officials. Have your mail addressed care of "Coal Age," Room 307, Union Trust Building, Washington, D. C., while at the capital.—Editor.]

State Administrators Granted More Power

An excellent opportunity to measure the caliber of state fuel administrators was presented on the occasion of the recent meeting of these officials called by Dr. Garfield. While there are some notable exceptions, the general opinion, formed by those who had an opportunity to estimate their ability, is that many unfortunate selections were made.

The state administrators were granted additional authority at this meeting in that they will hereafter determine from whom diverted coal is to be withheld. In order, however, to safeguard the exercise of this power, they have been asked to appoint an advisory committee of three men. It is specified that they must be familiar with the coal business in the state in which they are to serve. State administrators also have been asked to coöperate with the state councils of defense in the hope that diversions may be made so as to cause the least possible loss and inconvenience.

The Fuel Administration admits that the failure to specify from what consumer or area coal should be withheld, when it is diverted to meet an emergency, is apt to create new emergencies and therefore is generally unsatisfactory. It is feared very much that the inability of many of the state administrators to obtain a grasp of the situation is going to interfere seriously with the plans of J. D. A. Morrow, who is in charge of distribution.

Weekly Production Statistics

Production of anthracite coal continues far below the rate of that of a year ago. For the week ended Feb. 2, production totaled 9,423,000 tons. This was a decrease of 113,000 tons in the average per working day, as compared with average of the week preceding. The decline was shared by beehive coke. Production during the week ended Feb. 2 was 446,000 tons, or a drop to 74,000 tons per working day. There was a slight increase in anthracite shipments, which totaled 34,804 cars, in the week which ended Feb. 2. The figures given above are estimates made by C. E. Lesher, of the United States Geological Survey. The Survey receives weekly returns from such a large percentage of coal operators that their estimates rarely vary more than 1 per cent. from the final figures.

Coal-mining operations at bituminous mines throughout the country were conducted at 66.1 per cent. of full-time capacity during the week ended Jan. 26. Car shortage was responsible for 26.6 per cent. of this loss. Production increased decidedly in Illinois, where it reached 74.3 per cent. of full-time capacity. In Ohio, however, the showing during the week ended Jan. 26 was poor due largely to unfilled car orders. The mines in that state operated at 53.3 per cent. of capacity. Alabama made a good showing by operating at 87 per cent. of capacity. Southwestern Virginia attained 83.6 per cent. of full-time capacity.

A decided improvement was shown during the week of Jan. 26 at the byproduct coke ovens, where 70.6 per cent. of capacity was attained. Inability to secure coal was the only factor of importance limiting production.

Prices Increased in West Virginia

An increase in the President's schedule of coal prices has been allowed in the Kenova and Thacker fields of West Virginia. The new prices are: Run-of-mine, $2.40; prepared sizes, $2.65; screenings or slack, $2.15. This represents an advance of 40c. An additional 45c. may be added by those operators who have complied with the Washington wage agreement. The same price is to apply to all coal mined in Maryland and in Mineral, Grant, Tucker and Preston (in part) Counties of West Virginia.

More District Representatives Appointed

H. N. Taylor, of Kansas City, has been appointed district representative for the coal fields of Arkansas, Iowa, Kansas, Missouri, Oklahoma and Texas to serve as representative of all individual shippers and mines included in that area.

Mr. Taylor is directed to establish the necessary organization properly to conduct the activities of the office. He will arrange with each individual shipper and mine in his district to furnish notice of production, working time, free coal and shipments. He will compile reports of production, working time, car supply, shipments and

free coal and report such figures to Washington in totals at the end of each week.

The reports of District Representative Taylor, as well as those of the other district representatives heretofore appointed, are to be made to J. D. A. Morrow.

John C. Brydon, of Somerset, Penn., has been named the district representative of the Fuel Administration for the coal operations in Somerset County which are tributary to the Baltimore & Ohio.

G. B. Kilgore, of Norton, Va., will be the district representative for the counties of Dixon, Lee and Wise, in Virginia. He also will have charge of production in a portion of Russell County.

Coal fields in Arkansas, Iowa, Kansas, Missouri, Oklahoma and Texas are to be represented by H. N. Taylor, of Kansas City, who has been named district representative of the Fuel Administration. The district representatives collect from each mine data as to production, working time, free coal, shipments and car supply.

Coal fields in western Kentucky are to be represented on the Fuel Administration's staff by C. E. Reed, of Louisville. Mr. Reed is the eighteenth district representative to be appointed.

Our Coal Exports in 1917

Total exports of bituminous coal in 1917 amounted to 21,362,670 tons. This compares with 18,977,346 tons in 1916 and 16,764,857 tons in 1915. Anthracite exports in 1917 were 5,400,509 tons. In 1916 they were 4,165,652 tons and in 1915 they were 3,540,406 tons. Exports of coal to Italy fell from 1,735,072 tons in 1916 to 560,628 tons in 1917. The principal increase in coal exports was in those going to Canada, which country in 1917 took 16,256,006 tons of American coal. This compares with 11,839,447 tons in 1916. There was a slight increase in the coal sent to Panama; a decrease in the amount sent to Mexico; a slight increase in that going to Cuba; a slight decrease in exports for Brazil, while Argentina secured only one-third of the amount of coal which it has been accustomed to get from the United States.

What the "Closing-Down" Order Meant to the Country's Industries

An estimate of the losses caused by the closing-down order and the amount of fuel saved has been made by officials connected with the office of the Director General of Railroads. The estimate is as follows:

City	Fuel Saved	Wages Lost	Manufactures Lost
New York	$31,500,395	$357,498,000	$1,063,677,000
Chicago	27,486,908	213,757,000	381,535,000
Philadelphia	14,378,757	138,249,000	333,303,000
Detroit	5,446,475	69,447,000	178,099,000
Cleveland	10,903,284	67,351,000	153,925,000
Boston	3,845,540	49,444,000	134,234,000
Buffalo	6,824,615	34,818,000	89,520,000
Pittsburgh	10,470,576	45,066,000	96,779,000
Milwaukee	5,349,465	36,270,000	98,679,000
Baltimore	3,135,391	35,509,000	94,639,000
Cincinnati	2,198,284	33,159,000	96,735,000
Newark	3,424,436	36,647,000	97,163,000
Minneapolis	2,430,957	18,895,000	56,655,000
Jersey City	2,928,492	17,657,000	52,746,000
Perth Amboy	1,353,245	4,996,000	13,215,000
Rochester	1,569,614	26,600,000	82,167,000
Indianapolis	2,765,979	19,042,000	43,636,000
Akron	1,273,176	17,310,000	56,230,000
Totals	$137,285,589	$1,218,715,000	$3,122,937,000

Idle Monday Order Is Suspended

The order providing for heatless and workless Mondays until Mar. 25 was suspended on Feb. 13 by an official announcement from Fuel Administrator Garfield. The order was concurred in by Director General of Railroads McAdoo.

The only drastic regulation which still remains effective is that providing for a preference list to which coal will be shipped first, other industries and interests being forced to depend upon their supply from surplus coal.

The fuelless Mondays had been discontinued on Feb. 8 in North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Tennessee, as the needs for domestic requirements in those states are very much less than in the East, while the absence of congestion on the railroads in that section had made possible a general distribution of coal.

Mine Workers Favor Curtailment of Passenger Traffic

Curtailment of passenger service on all railroads of the country to allow the motive power thus engaged to aid in clearing up congested coal yards and switches, and to bring empties back to the mines, has been indorsed by two district executive boards of the Ohio Mine Workers.

These boards, representing subdistricts Nos. 1 and 2 of Ohio, indorsed the passenger-train reduction plan for 15,000 miners of seven Ohio counties in southern Ohio, who have worked less than 50 per cent. time in the past two months, because of the critical car situation.

"It's more motive power we need, and unless we get some action soon there is bound to be more serious want among the miners of this district," says George Cecil, of Wellston, president of subdistrict No. 2, which represents 3500 miners in Meigs, Vinton, Jackson and Lawrence Counties. This sentiment was also expressed by Sanford Snyder, of Athens, president of subdistrict No. 1, which represents 11,500 miners in Hocking, Athens and Perry Counties.

"Reduction of passenger-train service to give us more engines looks to me to be a way out of the present tie-up," was the expression of Conrad Weir, of Murray City, secretary of subdistrict No. 1.

An indorsement of the proposed passenger-train curtailment was given by nine coal operators in Jackson County, who have wired Director of Railroads McAdoo asking annulment of passenger-train service every other day, after the public receives due notice. Among the signers of this telegram is Jerry Morrow, for 52 years an operator in this district, who is president of the Jackson County Coal Club, an organization of 25 operators. "Such action would undoubtedly help a great deal and ought to be taken," says Morrow.

L. A. Snead, in charge of distribution for the Fuel Administrator, prior to the appointment of a representative of the coal-mining operators as manager of distribution has been assigned to the task of working out a method of equitable distribution of coal among domestic consumers. In this work he will visit a large number of localities throughout the country.

Minecdotes

Why Mine Mules Are Invariably White?

Some years ago, when mules were generally used for motive power in mine haulage, the operating officials of a large anthracite colliery received from the general office of the operating company a letter reading about as follows:

On Monday morning, Mr. ———, a representative of the "Philadelphia ————," will call on you. He is desirous of writing a description of an anthracite mine, and the methods employed in mining, for publication in his paper. Please show him through the mine and give him an opportunity to gather material for his proposed article.

The letter was signed by an executive official of the operating company, a gentleman not familiar with the details of mining.

The mine was a shaft mine, and a large producer. The principal workings were in the Mammoth seam, which had but slight inclination, and there were numerour gangways, headings, etc., in the neighborhood of the shaft bottom, through which several routes could be taken to walk from one side of the shaft to the other, without crossing the bottom of the shaft.

The operating officials were opposed to visitors entering the mine, unless they were mining engineers, or officials of other mines who came to see some specific operation, for such men could be relied upon not to interfere unduly with the hoisting of coal, as they would know how to keep out of the way of moving cars at and near the foot of the shaft.

The mine, being a large one, had besides the regular inside foreman two assistant foremen, one of whom was a young Welshman with a keen sense of humor and the ability to "put up a job" on a novice without cracking a smile.

When, on the particular Monday morning, the mine foreman told his assistants, with many imprecations and much grumbling, that the visitor would shortly arrive, and that he "hadn't any time to waste on him," the aforementioned assistant foreman, with twinkling eyes, said: "I'll take care of him, and when he comes out he'll be able to write a fine story." The foreman, knowing Tom's disposition, said "All right, Tom—here he comes now."

The newspaper man entered the office, introduced himself, and was informed that Tom would show him through the mine. Tom excused himself to arrange for an empty cage, and incidentally to see the hoisting engineer. The cage being ready, Tom and the reporter stepped on the cage, and the signal to lower was given. The engineer dropped the cage rapidly, and the visitor immediately sank to the floor and grasped one of the track rails, to keep the cage from dropping away from him. When the cage gently landed at the bottom, he was led, trembling in every nerve, off the cage, and was given a few minutes' time to partially recover and focus his eyes so that he could see to get around by the light of an ordinary miner's lamp.

Tom then took him on a long walk through gangways and headings around the shaft, repeatedly covering the same ground, showed him the pumproom and sump gangway, then through a passageway in which there was an old white mule used for numerous odd haulage jobs near the shaft bottom. As they approached the mule, and were about to pass his rear, or business end, his driver, a typical driver boy, yelled, "Look out fer that meule, he kicks!" Tom, of course, guided the visitor by the mule in safety, and then regaled him with many stories of the peculiar intelligence of mine mules. He told him that besides pulling the large mine cars, they pushed them, by "breasting"; that they knew to the minute starting time in the morning, when twelve noon arrived, starting time at one o'clock, and quitting time at night, etc., etc. He also told him many weird tales of the deviltry and visciousness of mine mules generally.

In the meantime, he managed, unknown to the visitor, to tell the driver boy to lead the mule around, so that as he walked the visitor repeatedly through the same passageways, they would frequently meet the mule. In due course, as Tom was careful to keep the visitor out of the way of moving trips, and he saw no other mules, he commented on the number of white mules in the mine, and of course Tom explained why white mules were used. Several times, either before or after they passed the mule, the driver would tease him and start him kicking.

Then, after Tom had taken the visitor into a productive part of the mine, and the sound of the firing of shots had given him an uncomfortable feeling, he was taken to the foot of the shaft and hoisted to the surface. With many expressions of thanks and protestations that "never again will you get me inside a coal mine," he left.

Two days afterward the Philadelphia ———— published a three-column article on "How Anthracite is Mined." Among many other statements that amused its readers in the coal regions, appeared the following:

Owing to the darkness in the mine, only white mules are used to haul the coal to the foot of the shaft, because they can be seen much more easily than those of other colors. These mules, while trained to a high degree of intelligence in their work, are invariably bad tempered and vicious. It is claimed that the inky darkness of the mine has a great effect in developing both the intelligence and visciousness of mine mules.

Cement Needed for Concrete

The following table, taken from "The Ransome Book," shows the amount of cement used in the making of concrete having various mixtures:

CEMENT USED PER CUBIC FOOT OF CONCRETE

Mixture	Sacks	Mixture	Sacks
1 : 1 : 1	0.5404	1 : 1 : 1	3.375
1 : 1½ : 3	0.2808	1 : 1½ : 3	1.895
1 : 2 : 4	0.2220	1 : 2 : 4	1.498
1 : 2½ : 5	0.1848	1 : 2½ : 5	1.247
1 : 3 : 6	0.1570	1 : 3 : 6	1.060

An electric machine has been installed in the Crescent mine, near Mineral, one of the largest mines in Cherokee County. Similar equipment has been contracted for at other of the larger mines. President Howat is now preparing to make a machine-coal scale at Osage City for the operations of the Jackson-Walker Coal and Mining Company.

THE LABOR SITUATION

General Labor Review

The mine workers are still deprived by the serious car shortage of a chance to make a good living, buy Liberty Bonds and War Savings Certificates. At the recent Indianapolis convention it was stated that in one field only four days' work were secured in an entire month. One of the delegates declared that he reported for work eight consecutive days and only got two hours' work in all that time. Of course, the Geological Survey's figures, which have a broader scope, do not show these extremely unfavorable conditions, because they are too local; but even in that report it is shown that the car shortage in the high-volatile coal field of southern West Virginia mounted to 70 per cent. in the week that ended Jan. 26.

The Southern coal fields, of course, showed the least evidence of a car shortage. The weather conditions practically determined the situation North and South. In the Arkansas semi-anthracite mines there was absolutely no shortage of cars in the week ending Jan. 19 and only 2.1 per cent. in the week following. But in this field mine disability rose during those two weeks to 70.7 and 10.4 per cent., an extremely bad showing. The districts which show less than 10 per cent. of car shortage in the two weeks were Iowa, Alabama, Arkansas (semi-anthracite), Montana and Wyoming, Colorado and New Mexico, Oklahoma and Arkansas (bituminous coal), also Kansas and Missouri.

Fairmont Region Hard Hit by Car Shortage

Not every region is short of equipment. It is said in a Kemmerer, Wyo., exchange that the Union Pacific R.R. at that place was so well supplied with transportation facilities that it purposed to lay off some of its freight-engine crews. Among the sections hard hit by the shortage is the Fairmont region with 62.5 and 52.1 per cent. car shortage in the two weeks considered. The Junior-Philippi field along the Tygarts Valley River, Barbour County, West Virginia, had a shortage of cars which decreased tonnage in the two weeks 56.4 and 43.7 per cent. respectively.

Just at present strikes are not numerous. The difficulties are of another kind. The companies are trying to get the utmost out of their men, especially where cars are plentiful, which is not, of course, a general condition. The Philadelphia & Reading Coal and Iron Co. finds its position precisely opposite to that obtaining in most of the bituminous mines of the country. As J. L. Lewis, the statistician of the union, has pointed out, the shortage in bituminous mines has been principally in the day men and not in miners. In order to help the day men and make their lot more pleasant they have been awarded the larger increases when scales had to be made. But at the Reading mines, at least at the Alaska colliery, at Mt. Carmel, the excess of force was in company hands, or day men, and not in miners. Sixteen men repairing tracks, opening ditches, building brattices and other light work were offered employment in the mining of coal. They refused to exchange their positions and were discharged, with a notification that they must drive gangways, chutes or breasts or apply for work elsewhere.

On Feb. 8, the operators in the Alabama district were notified by the Fuel Administration, Order No. 370, that they would not be allowed a 45c. increase in the price of coal. The contract made recently by the operators does not provide for an increase in wage, and consequently, though satisfactory to the Fuel Administration and approved by it, the contract is not a ground for any price increase.

There seems a probability that fine weather will soon remove all risk of a fuel shortage in Alabama. Dr. A. C. Williams, chairman of the state fuel committee, is doing much toward gaining pledges among the colored miners to do more and better work. Every mine village he has visited has given him a large and enthusiastic audience and he has aroused a greater interest among colored workmen than they have hitherto shown.

The anthracite region seems to have a few men who are disposed to strike and make trouble. In the issues of the last two weeks the trouble at Laflin with the Traders Coal Co. has been recorded. On Feb. 6 several more miners went to work, but the others still held out and the tonnage of the mine did not reach capacity. This week a strike must be recorded at Moosic, which is quite close to Laflin and one of the little group of disaffected towns. On Feb. 7, 200 employees of the Lehigh Valley Coal Co., employed at the Broadwell colliery at Moosic, went on strike for the second time in two weeks. On both occasions, the difficulties related to wage scales. The strike was called by the union grievance committee.

Going back a little in time but pursuing a steady course northward, reference should be made to a strike at Taylor. Taylor lies between the disaffected territory and Scranton. On Feb. 4 1100 men and boys at the Archbald colliery of the Delaware, Lackawanna & Western R.R., Coal Department, went on strike because of a grievance presented by eight foreign miners. The strike was called off on Feb. 7 after it had been agreed that the mine superintendent and members of a committee would visit every section of the mine and adjust the scale of wages for mining both on pitch and level. The men had been receiving $2.72 per car for coal mined on a pitch. When the men were moved to a level place they wanted not only the $1.30 the contract requires, but $2.72 per car.

Trouble at Henryetta, Okla., and Drumheller, Alta.

The next strike to record is far away from the anthracite region—Henryetta, Okla. The 200 men employed by the Victoria Coal Co., at Henryetta, went on strike, Jan. 21. They have recently returned to work. The men struck because of a dispute over the water furnished to the men in the company houses.

On Monday, Feb. 4, 2000 mine workers in the Drumheller field, Alberta, went on strike. The trouble started on Saturday, Feb. 2, 175 men walking out because, according to reports, the operators refused to run a closed shop. About 70 per cent. of the mine workers are aliens, 40 per cent. being alien enemies and only 30 per cent. Canadians.

In Illinois the Peabody Coal Co., recognizing that the men in its employ were aiding the Red Cross in their attendance at the Kinkaid Centennial celebration, has decided to refund the $3 fines it had assessed under the automatic penalty clause against the men employed at its No. 7 mine at Jerseyville and its No. 8 mine at Tovey for taking a day off to attend the celebration.

Miners Ask for Better Transportation

Mine workers in many places are seeking better transportation. Two hundred mine workers at the mine of the Devereux Coal Co., located 2½ miles northeast of Springfield, Ill., have filed a petition with the State Utilities Commission of Illinois asking that train service to and from the mine be supplied. The miners complain that a train runs to the Peabody mine near Sherman every day, but it will not stop at the Devereux plant to take men from there or permit them to get off the train. The train runs within 100 ft. of the plant and might just as well make the stop.

A petition has been prepared for submission to the Indiana Public Service Commission asking that a miners' train be run on working days on the Pennsylvania R.R. between Harmony and Glen Ayr mine. On this petition appear the names of 508 coal-mine workers. Operators having mines along the track have also signed a petition. Harmony is in the Brazil field of Clay County, which is gradually growing less productive. The Glen Ayr mine is near Terre Haute and like the other Vigo County mines comparatively new and active.

Four hundred O'Fallon and Lebanon miners refused to go to work at the St. Ellen, Nigger Hollow and Prairie mines one morning last week because the East St. Louis & Suburban Electric Railway Co. sent only two cars to transport them to the mines. The St. Ellen mine was closed entirely for the day and the other two were able to work at part force. The officials of the miners' unions say they will make a report on conditions to the Fuel Administrator.

The problem of transportation is a growing one. Old mines are closing up their activities. The miners who built homes adjacent to them are left without opportunity for labor and they are seeking rapid and cheap means of reaching new mines and returning at night to their homes. This fact and the disposition to work where the coal is thickest and conditions most favorable together with the growing desire for life in larger communities will make the mine worker a leading factor in the transportation problem and will cause him also to be a great advocate of shorter hours. A man cannot labor a full day who lives a long way from his work.

Severe Discipline at Mines

Recently a Russian miner employed at the Oak Hill mine, near Belleville, Ill., near St. Louis, Mo., was arrested for firing a shot, which he found in his room unexploded, when he returned to his place in the morning. All the men were in the mine when the shot was fired. Some fled to the shaft and others made an investigation. For one reason and another no one worked that day as a result of William Matthews' imprudent action. When the case came before the county judge the man pleaded guilty, and was offered his choice between a fine of $100 and costs and 30 days in jail, and $200 and costs. After a week's consideration the man decided to accept the higher fine and save the month in jail.

The action of the miner seems to have met with the general disapprobation of operators, mine workers and the public. The heinousness of his offense caused the judge to give him the maximum penalty. Some people have doubted whether laws against such offenses can be enforced, because witnesses are hard to obtain and juries are slow to convict. Here at least is an instance where witnesses were apparently not lacking. It is ill to assume that the public and the mine workers are not interested in safe mining, for in cases of negligence, the importance of which they understand and appreciate, there is little hesitation.

Another instance in which a mine worker was fined for an offense against the mining laws is that of Philip Lipnok, who was arrested at Farmington, near Fairmont, W. Va., charged with breaking open a safety lamp in a gaseous mine. However, Lipnok had extinguished the lamp before breaking it so he did not risk his life or that of his fellow workmen. However, he was fined $50 and costs.

Suit Against Mine Workers' Union

Depositions were taken in the United States Court at St. Louis, Mo., in the $600,000 damage suit of the Pennsylvania Mining Co. A violation of the Sherman antitrust law is alleged. The suit is the outgrowth of a strike in June, 191[illegible], at the mines of the Pennsylvania Mining Co., a Scranton, Penn., corporation. The mines are located at Jamestown, near Clarksville, Johnson County, Arkansas.

The company alleges that the strikers were mobilized in a colony of 200 tents near the mine, that they intimidated employees, destroyed the pumping plant of the mine with dynamite and fired on employees in their homes. It is claimed that the strike was the culmination of a conspiracy of the union to hamper the output and interstate shipment of nonunion coal. Peter Hanraty, former president of the union for district 21, one of the defendants, testified that he placed two organizers in the mine who worked secretly to establish the group system. He said that the union from 1910 to 1915 spent $200,000 in propaganda in an effort to unionize the "Jimtown" mine and that the union determined on its unionization because the union mines were unable to sell coal in competition with the cheap coal produced in the nonunion operation.

Women Get Same Pay as Men

The United Mine Workers of America have opposed the employment of women, urging that the dilution of labor was entirely unnecessary, as there was plenty of men to do all the work needed. It was also said that women were to be hired because they would work for less pay than men.

It has been so clear that there is a scarcity of labor in the anthracite region that the labor leaders from the anthracite districts are not among those who contend that there is no labor shortage. They are quite ready to concede it. When women were employed as clerks, weighmasters and supply-house officials in the anthracite region an investigation was made. It was found that the girls and women were working, but that they were receiving the same pay as men, so no complaint has been entered. Five more young women have recently been employed by the Susquehanna Collieries Co. and more are to be added.

Lawson Repudiated in Colorado

John R. Lawson, the leader of the miners in the Colorado strike, has been defeated by George O. Johnson, of Chandler, as president of the United Mine Workers of America in district No. 15. Johnson got 377 votes majority.

Lawson, who was tried and convicted of murder in connection with the southern Colorado strike, has been getting more and more unpopular of late. This was shown at Indianapolis, where he was denounced as a labor agent of the Victor American Fuel Co. Someone alleged that when in jail he was secretly assisted by the agents of the coal companies.

It was alleged that he was fed with chicken twenty-one times a week, without, it may be added, developing any clerical leanings. Luke Brennan, of Colorado Springs, was chosen a member of the International Executive Board. None of the "Lawson ticket" was elected, the administration carried their candidates into every office.

Strike at Drumheller Continues

The 1500 mine workers at Drumheller, Manitoba, Canada, deny that their strike is for the closed shop. They say that all they desire is the privilege of organizing a union and that this has been denied them. There seems some probability of violence, but it is being met by the Royal Northwestern Mounted Police under Major Fitz-Horrigan who are quartered at the Rosedale mine. Warrants have been sworn out by union officials for Alfred and Kenneth Moody, of the Rosedale Mining and Clay Products Co., and for several other employees of the company. The union officials charge the company's officers with having threatened the union organizers. The warrants were served on Feb. 6.

As many of the men are foreigners, and as bootlegger whiskey is circulating there is some fear of trouble. F. E. Harrison has been sent by W. H. Armstrong, the coal commissioner of the district to investigate the situation. President Thomas Biggs, of District No. 18, which includes all western Canada accompanied him. The Saskatoon, Sask., city council, board of trade and the Fuel Dealers' Association of that city, have called on the government at Ottawa to interfere as Saskatoon is mainly dependent on the coal from the Drumheller field.

EDITORIALS

Effect of the War on Labor Problems

THE war affords an opportunity to consider labor problems without the bitterness that spoils the discussion during times of profound peace. The combativeness of labor and capital is sidetracked. It is venting itself on the enemies of both. Thus it is that capital is learning to respect the leaders of labor, and labor is learning to appreciate the genius and constructiveness of capital.

And when both labor and capital are surrendering to the national needs of the war; when labor is giving its blood, its leisure, its privileges, its comforts for a great, a supreme national purpose; when capital is giving blood and services to the same great cause, there cannot fail to be a common sentiment regarding those matters about which labor and capital have too long and too often quarreled.

It is surely well when the war is still going on and all are consecrated to a great common end; when all can talk, without the heat of controversy, that the great problems of labor and capital shall be solved; not for all time nor in their entirety (when was any matter, even of science, so settled?), but solved, at least, in part and in their main essentials.

It is a time of earnest thinking. Some are hoping that capitalism will come to an end. But there must always be capital, for it is the machinery of commerce. The pick of the miner, the needle, the tamping tool, his lamp, his home, his furniture are all capital wherewith he produces coal and earns his daily bread. The miner is hourly in need of these instruments of production, and to buy them he is compelled to put by something or he must consent to put by something later to pay for them. No one can keep all he produces. He must, like the farmer, hold back something for future seeding.

And there are other forms of capital essential to the economic production of the miner—the mine workings, the haulage roads, the tipple and its power house. These are the machinery of production. We cannot do without them. Either the state or the manual worker or the management must have them, for we cannot do without them. We must put something by or we will not have them. That something is capital.

Just now the railroads, deprived of capital necessary to enable them to advance with the rest of the country, have failed to do their duty, and hence there are shortages of fuel, idle days for miners, idle days for industry, lack of food and deprivation of comfort. The railroads are without equipment because they have spent all they earned and have not been accumulating capital. Labor is nothing without the support of the past product of labor. You cannot grow a crop without seed, or harvest it and beat it into food without using the product of past industry.

And something must be given to those who save and produce this capital, or no one will save it. Profit is the wage of capital. The capitalist is much like the working man, he will not work or let his capital work without a wage. Would the working man work if he knew he was not going to be paid?

But we say profits are too large. Perhaps we shall never be able to agree as to that matter. But surely if profits are kept down to a meager amount, and the capitalist is going to stand the losses of false calculation or unfortunate conditions, he is soon going to expend his whole capital. On this investment, perhaps, he loses and on that he wins. One year he has favorable balance and the next a loss. He will always have to cast up his earnings against his losses. Sometimes he builds an industry, such as is the Panama or the Erie canal, on which he loses, as the nation and the State of New York are losing in those enterprises.

So he must find another extremely fertile source of income or he will be a loser. And if all are losers, then the world is loser. There will be no wealth at all. There will be no capital if the produce of toil does not have a favorable balance.

Some are saying that the war will bring profit sharing of labor with capital. Capital might be willing to try it, but the working man does not want it. The mine workers have repeatedly repudiated it at their national conventions and by their leading spokesmen. They have asked instead a permanent wage increase as did the mine workers last year in central Pennsylvania, the same for all persons engaged, whether in profitable or unprofitable toil. They do not wish to expose their earnings to the uncertainties with which capital has to contend. Similarly, the mine workers in the anthracite region condemned the sliding scale. They wanted higher wages not profit sharing, and the copper miners will stand by the sliding scale only so long as it slides upward and not downward.

Nor does labor take kindly to the communistic idea. There have been mines operated on a coöperative basis in Illinois and elsewhere. But the men working in them have been put out of the union, because miners employed at these coöperative mines have been so anxious to work steadily in slack periods that they have operated the mines at a loss rather than lie idle, and made deductions from wages to cover that loss. As a result the price at which they sold their product was continually forced down to the general impoverishment of all the other workers in the coal industry.

In fact labor, as a whole, might look with favor on bonuses which became progressively larger, but it does not remain contented when bonuses shrink, are cut off, or are replaced by assessments on wages. Nor do union men favor national ownership which deprives them of liberty and puts them under an autocracy, not less but more inflexible than that of capital.

Labor, as a whole, is not opposed to capital, though it is true that it does seek to have all excessive profit cut off, especially such profit as is made out of tem-

porary necessities, and which bear with unreasonable hardship directly on the working man in the purchase of a livelihood. Rightly or inadvisedly, but certainly naturally, labor will endeavor to prevent inordinate profits even though thereby the law of supply and demand seems unduly interfered with. The workman will argue with some show of truth that a profit twice that which is usual will, eventually, if not immediately, work the readjustment called for without creating any unnecessary disturbance of living conditions.

It will allow those creating a certain necessary kind of product all the opportunity needed to thriftily expand and supply the field, and will bring in enough outside capital to serve the industrial need. In order to produce quiet during the war and even after the war, excessive profiteering may well be prohibited as the President's Mediation Commission has just suggested. But the miner will naturally want to know why profiteering in coal is wrong and profiteering in cotton, wool and all foods but wheat is permitted.

Conservative labor believes in capital and is working always to acquire some of it for itself. It is frugal and forward-looking, and it will always oppose itself to radical labor which is seeking to provide that the whole product of labor will be used up, destroyed and consumed as fast as it is produced. The differences existing are hardly between capital and labor so much as between conservative and radical labor—the labor that realizes that pay comes from product, and the labor that believes that by agitation each individual workingman can secure a competence far larger than that which labor produces.

An individual industry can arrange to secure for itself excessive payment. It can always make other industrial workers pay it excessive wages so long as those wage earners are willing to assist it in getting the exorbitant wage it desires. In the last analysis, it is the worker pays the worker, and it is the worker who is interested in opposing wages which are inequitably high.

Continuous Vernier

ON PAGE 329 of this issue of *Coal Age* is an interesting discussion of deflection angles and azimuth with special reference to coal-mine engineering. This matter ever has been a bone of contention among certain mining engineers and probably has been settled frequently by each man selecting the method that most appealed to him.

Transits in the anthracite field of Pennsylvania were, at one time, frequently graduated so as to give quadrant readings. This graduation was especially well adapted to continuous vernier work. The quadrant readings gave every alternate course direct, and the intermediate courses were exactly 180 deg. from the true bearing, as a little thought will readily disclose, and were set down in the notes in their correct quadrant. The telescope was not plunged.

The needle on the transit was released at each station set-up and read each time a B. S. or F. S. was taken, both as a check on the angle and also on the quadrant reading. The correctness of the quadrant readings as recorded were thus never for a moment in doubt. Local attraction often deflected the needle, but the B. S. and F. S. needle readings should show equal deflection from the vernier courses and serve as a valuable check nevertheless.

In mentioning checks, an old engineer once told his assistant: "You will often make mistakes; every engineer does, but do not let them get out of the office. Surround all your work by every practical check so as to discover mistakes before they do any harm."

In continuous vernier work, a word of caution might save annoyance at times. After the vernier is once set, clamp the plate and vernier screws sufficiently tight to prevent any possibility of their slipping; and also guard against anything rubbing on the tangent screws. In carrying the transit from station to station, or in setting up the instrument, it is very easy for the sleeve to brush against a tangent screw and give it at least a part turn. Guard against the possibility that something may touch the tangent screw between transit settings and thus cause the horizontal limb to move.

The United States Geological Survey fills in most of the topography by plane table, but continuous vernier is merely a modification of this method; if a transit is provided with stadia wires and a leveling rod is available, the two systems approach closely in efficiency as far as the ordinary requirements of coal-mining engineers are concerned.

Standards Rather Than Methods Are Desired

THE fuel administration in Luzerne and Lackawanna Counties in Pennsylvania has ordered the operators to prepare their coal in the customary way "by passing the same through a breaker or a washery, so as to properly size and remove the rock, slate, dirt and ashes (*sic*) from the coal." It is good news that this action has been taken. It has certainly not been instituted any too soon. There has been for some months too much impurity and undersize in the coal as delivered to market, but it must be remembered that washeries and breakers can be run in such a way that they will not exorcise the evil in the coal as it is delivered to them.

Screens and pickers can be regulated to give a minimum result. They can be arranged to permit pea to be sold as chestnut and chestnut to be sold as stove, while rock, slate and bone coal can be allowed to masquerade as a prepared product. The only solution is to be found in an inspection of every car with a report to the Government of its condition. While the requirements of peace times in regard to thermal units were in many cases somewhat excessive and their imposition burdensome to the industry and hence to the public, a reasonable inspection which casts out coal having excessive slate and sends it back to the washeries and breakers is grievously needed. With all the clamor for coal it is natural that some men who seek money rather than the national welfare will let steam-size coal run into the prepared-sizes chute, and purposely reduce the selective efficiency of the slate pickers.

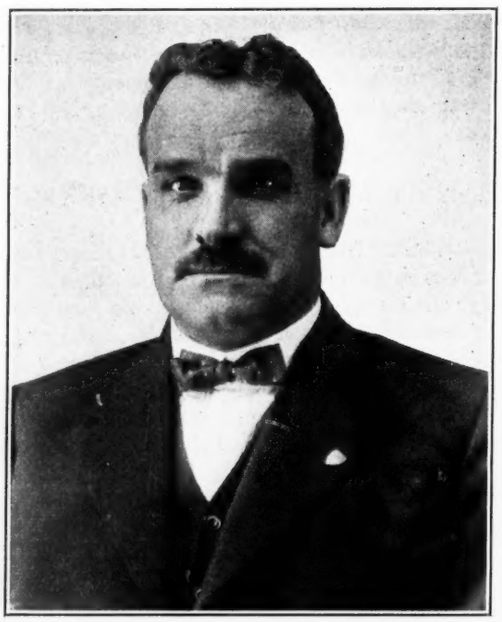
But we cannot believe that Campbell and Williams will be satisfied with a perfunctory compliance with their order. The days of the unscrupulous are, we feel sure, numbered. The conscience of the coal industry is aroused and in a few days the fuel administrators will put a crimp in the practice of shipping to market everything that looks like coal.

Who's Who In Coal Mining

Seward E. Button

To have risen from the humble place of day laborer to the highest position in the mining industry in Pennsylvania, to have controlled the operations of thousands of men in his 18 years' experience as mine foreman and superintendent without once undergoing a strike, even for a day; to have reclaimed one of the most gaseous mines in the region to a point of safe operation—these are a few of the high lights in the career of Seward E. Button that show that the field of opportunity is still open to the youth of ambition, perseverance and energy.

Seward Button, the new chief of the State Department of Mines of Pennsylvania, is an old-school miner, his



SEWARD E. BUTTON
Chief of State Department of Mines of Pennsylvania

ancestors having delved in the mines of England for generations back. He is a son of Owen Button, and was born in Somersetshire, England, on Oct. 5, 1875. His years of schooling were scanty, and at the age of 15 years he came to America, to the home of an older brother who had settled at Avoca, Penn. He went to work at once as a day laborer at the Hillside colliery of the Hillside Coal and Iron Co., and while he was yet a youth gained certification as a miner. He was employed for a number of years at Carbondale and again at Peckville, to return to Avoca, where, ten years from the time he began work as a day laborer, he became a mine foreman at the Hillside colliery, where he was engaged for four years. For five years he was foreman at the Erie colliery at Jermyn, and then went to the Temple Coal Co. to become superintendent of the Mt. Lookout colliery at Wyoming, where gas conditions had become particularly bad and had just been responsible for a serious tragedy, costing the lives of a number of men.

It is noteworthy that in the nine years Mr. Button has been superintendent of the Mt. Lookout there have been no disastrous gas explosions there, and it is now safe to work in this operation with a naked lamp. This achievement has gained for the new mine chief a distinct reputation as an authority on mine gases.

A pointed commentary on the personality and ability of Mr. Button is supplied by the fact that in his 18 years of authority as foreman and superintendent he has not been obliged to face a single strike.

Mr. Button has been a conscientious worker for the advancement of the mining industry and of his fellow workers. He has been active in the promotion of the Pittston Mining Institute and is its president. On various occasions he has lectured before the institute on mining problems. He is a member of the Engineers' Club of Northeastern Pennsylvania.

Although a sound Republican, Mr. Button has never taken an active part in the chaotic politics of the Keystone State. He has been doing his bit for his country since last June by serving as a member of the Second District Draft Exemption Board of Luzerne County.

Mr. Button went to Harrisburg on Feb. 12 and assumed his office. He will continue his residence at Wyoming.

The new mine chief is a married man with two sons. The older, 20 years of age, is a driver boss in the Mt. Lookout colliery. The younger, at 18, is an engineering student at Cornell University.

Shortage of Coal Increases Demand for Illuminating Gas

That the coal shortage has greatly increased the demand for gas is shown by the report of the Consolidated Gas Co., of New York, for the year 1917. This report shows that until December of last year the combined maximum day's output of that company and its affiliated companies had amounted to 125,148,000 cu.ft., but that on Dec. 15, due to the low temperature and the extraordinarily severe weather conditions, the output amounted to 129,959,000 cu.ft. On Dec. 28 the output was 137,310,000 cu.ft., and on the last day of the year it was 155,006,000 cu.ft. The output for the last three days of the year aggregated 460,613,000 cu.ft., an increase over the three corresponding days of 1916 of 134,297,000 cu.ft., or 41.16 per cent.

The price of boiler coal, used in generating electricity, increased 59.2 per cent., and of anthracite and bituminous coal used in gas manufacture 11.3 per cent.; the average increase in the price of all varieties of coal used amounted to 34.3 per cent. The increase in the price of gas oil was 66.2 per cent., and it has increased again this year 30 per cent.; the increase in the price of gas oil in 1917 over that of 1916 amounting to 116.6 per cent. The increase in the price of these items alone added $4,530,600 to the cost of manufacturing gas and generating electricity during the year 1917.

In 1916 the Consolidated Gas Co. and its subsidiaries operating in Manhattan and The Bronx used 119,238 tons of coal, coke and boiler fuel; 415,016 tons of coal and coke for generator fuel, and 352,611 tons of gas coal was carbonized, a total of 886,865 tons. The New York Edison Co. used 655,805 tons of coal, and the United Electric Light and Power Co. used 204,928 tons of coal during the same period.

Broken locomotives and bad weather caused the shortage of coal from which these Newark, N. J., people are suffering.

The miners of America are proud that THEY never failed to do their utmost to provide the needed fuel.

Courtesy of Newark Evening News

Line at coal yards of Lehigh Valley Coal Sales Co., Eighteenth Ave. and Lillie St., Newark, N. J.

The weather is better now and the miners, we hope, will have even a better chance to make scenes like this unnecessary.

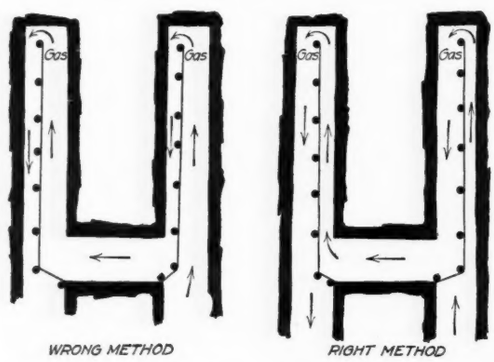
DISCUSSION BY READERS

Erecting a Line of Brattice

Letter No. 1—Having followed the discussion in *Coal Age*, regarding "Clearing a Heading of Gas," it has occurred to me that the difficulty experienced in removing gas from the face of a heading is often due to a wrong way of building the brattice. As this is a very serious matter, and one that should be thoroughly understood by all mine foremen and firebosses, it seems to me that a discussion along this line would prove of interest and value.

Without referring, further, to the suggestion of hanging a curtain 90 ft. back from the face, in the return airway, which would be a strange thing to do, let me explain my ideas in regard to the right and the wrong way of building a brattice to remove gas from the face of a pair of headings.

On the right of the accompanying figure, I have sketched the arrangement that experience has taught



REMOVING GAS FROM FACE OF HEADING

me is the most effective in removing gas. The wrong method, which is commonly used is shown on the left.

By way of explanation, let me assume that the main entries are driven due east and gas has accumulated at the faces of the 4 and 5-N headings driven off the main east, the 5-N being the intake and the 4-N the return for that section of the mine.

Proceeding up the intake or 5-N heading, a line of brattice should be started from the outby corner of the last crosscut on the west rib of this entry. From that point the canvas should be carried across the entry to within 2 or 3 ft. of the east rib and then carried along that rib toward the face of the heading. The aim is to make the air space on the intake side of the brattice much narrower than that on the return side.

After the brattice has been extended to the face of the 5-N, and the gas removed from that heading, another brattice should be started from the outby corner of the same crosscut, on the east rib of the 4-N. As shown in the figure, the brattice should be carried along the east rib toward the face, making the air space on the intake side, here also, smaller than that on the return side of the brattice. This arrangement gives the air greater force at the end of the brattice where it strikes the gas.

On the other hand, when a brattice is erected as shown on the left of the figure, and the intake side is made wider than the return side, the effect is to produce eddies in the air current at the head of the entry, which greatly interferes with the removal of the gas.

STEVE GOSNELL,
Hallidayboro, Ill. Mine Examiner.

Overlooking the Salaried Man

Letter No. 1—The reference to "Injustice to salaried employees" made in a letter signed "Equity," *Coal Age*, Dec. 22, p. 1068, calls to mind an excellent Foreword that was published in *Coal Age* more than a year ago. [Vol. 10, p. 375.] It was an open letter addressed to presidents, directors and managing executives of large concerns, and drew attention to the fact that the salaried employee is rated and paid on a different basis than that applied to day men and apprentices.

While it is true that the salaried class of employees is proportionately small and the number of applicants large—a fact which would tend to lower the rate of pay in that class—the chief reason for the difference between salaried men and those who perform day labor lies in the fact that the latter class is organized to drive wage bargains with its employers.

The question is a broad one and applies alike to all industries and professions. The law of supply and demand does not altogether remove our perplexity. There appears to be another factor operating to enlist the interests of employers of labor in favor of the one class, while the other class is seemingly overlooked or regarded as of less importance.

UNFAIR DISCRIMINATION IN CLASSES OF WORKERS

For illustration, compare the school teacher and the lawyer, or the minister and the doctor. The lawyer's services are generally more highly regarded and his reward greater than that of the school teacher, notwithstanding both are equally essential. Likewise, the services of the doctor are generally held in higher esteem, in respect to the amount paid for his services, than is the work of the minister; yet both supply what the race needs.

To the candid mind, the situation is one that should be remedied; but how? In the broadest sense all employees serving as clerks, bookkeepers, timekeepers and others holding official positions and paid a stated salary, are affected, and every community has many such men whose labors should be (but seldom are) rewarded according to their faithfulness.

Much could be done in communities through education and influence. Large corporations or companies holding controlling interests in local affairs can exert an influence for good, and the responsibility rests on

such more heavily than it does on the smaller companies, who can only lend their aid to a limited extent by serving on school boards, boards of trustees and executive committees.

In this connection I do not want to be understood as failing to appreciate the splendid work done by many large companies along welfare lines. That this work can be extended and made to apply to the salaried class of workers will not be denied. It should be extended to include school teachers and ministers serving the community. But, we are particularly interested, here, in the salaried men of the coal industry, to which the Foreword mentioned had particular reference. As bearing on this question, allow me to cite a single instance, which is but one of many, showing the need of giving more careful attention to and rewarding more justly the pay of salaried employees.

Injurious Effect of Favoring Certain Classes of Workers

A friend who works in a railroad shop recently told me that he began work in the shops as timekeeper. In order to increase his chances of promotion he studied shorthand, typewriting and bookkeeping in his spare hours. It was not long, however, before he realized that the time and effort he was putting forth would not pay in the end. The result was that he became an apprentice, and in five years was working for more money than he would have made in ten years of promotion on the office force. The same man mentioned others who had given up good positions in the office to become apprentices, because, from a financial standpoint, it paid.

There are thousands of ambitious men working as apprentices in our shops who would make good executives, engineers, electricians and inspectors, were these positions for which they are fitted made more attractive. It goes without saying that the companies are the losers in the end. It is called "good business" when a manager is able to secure a $75 man for a $100 position, and many an employer yields to the temptation to pay his men as little as will hold their services, rather than pay what the position is worth.

In closing, allow me to name a few of the qualifications of the faithful salaried man: He has ability and is always on the job; he systematizes his work, by which he accomplishes more at a reduced cost for helpers and assistance; he is reliable and meets conditions as they arise; he is trained for his particular work; he is loyal to the company interests, which he constantly strives to safeguard; he never threatens a strike, but labors day and night to accomplish the work in his charge. For this faithful service, let me ask if he should not be amply rewarded.

GEORGE N. LANTZ.

New Straitsville, Ohio.

Helpless Helpers

Letter No. 1—Reading "The Story of the Helpless Helper" calls to mind an incident of my boyhood days that impressed itself so forcibly on me that memory often brings back the scene I then witnessed. It has taught me that when a man is seeking help or asking for information, to hear him out in what he has to say and then assist him in the best manner possible.

At the time of my story, I was working for the Broadway Coal Mining Co., at Simmons, Ky. My duties were those of a trackman. I was talking to the boss, who was resting himself, on the parting, when a boy came out of the mine and told the driver who was there and who hauled the coal from his room that, in switching the empty car in his place, it had run off the end of the track and he was unable to put it back again.

Overhearing the complaint, the foreman asked the boy if the car was loaded, and being told that it was not, replied, "Well, we don't put empty cars on the track; but when a loaded car is off the track, we are willing to help put it on again." The boy stood a while, studying over the matter, when an idea seemed to strike him and he went away. Knowing that it was impossible for him to get the car back onto the track, he decided to load it where it was.

Having finished the task, the boy again sought out the foreman, whom he found in the same place as before. Walking boldly up to him, he said: "Mr. Jones, that car is loaded now. Will you have a man help me put it on the track?" The boss was not slow to see that the joke was now on him, and, without further delay, he gave the driver orders to put the car back on the track.

The boss, in this case, was a "helpless helper," refusing to give the boy the assistance that he had asked and had a right to expect. Like others of his kind, the man did himself a greater harm and retarded his own work, or the work in his charge, more than he delayed the boy. It is a simple incident, but teaches a good lesson that foremen and others will do well to learn.

G. D. YORK.

Harrisburg, Ill.

Conservation of Mine Gas

Letter No. 3—I was glad to read the letter of my old friend, H. G. Davis, on the Conservation of Mine Gas, *Coal Age*, Jan. 26, p. 210. Like him, I have been "watching and waiting" for some of the big fellows who know all about gas to tell us how the waste gas of the mines is to be collected.

Candidly, it struck me that the previous letter of E. B. Wilson, to which Mr. Davis refers, was too pessimistic, in regard to the possibility of conserving the gas that is now wasted in such large quantities in the anthracite fields.

We all know this is a big job, but we should regard it in the same light that our honored governor has looked at it, which caused him to remark, "Watch some fellow do—the impossible." I am willing to admit that the proposition may be impossible of accomplishment by any one man; but I have great faith in what may be developed by a broad discussion of the subject in *Coal Age*, by practical mining men, if they will give it their attention. In the hope of assisting in a discussion that may develop some practical means of carrying out the project of saving the gas, let me suggest what might be called a "gas mine."

In this connection it has occurred to me that the large boundary pillars left between adjoining workings, in the anthracite mines, might be utilized by driving a heading into the center of such a pillar and then driving both ways on the center line and extending this central heading practically the length of the pillar.

When this has been done, the opening could be sealed off with a heavy concrete wall into which a pipe should be built, say 10 in. in diameter, for the purpose of piping the gas to the surface.

There are, of course, other ways of collecting large quantities of the gas in our coal seams. Boreholes have often been suggested for this purpose. It seems to me that, while this is a good suggestion, the flow of gas through these holes could be greatly accelerated by connecting them with a vacuum pump that would exhaust the gas from the mine. The subject is one that has greatly interested me, and I cannot but hope that some of these schemes will be tried out in a manner to determine their practical value. W. A. BARRETT.

Nanticoke, Penn.

[The scheme suggested by this correspondent, in respect to what he styles a "gas mine," will hardly be considered as a safe proposition in connection with a mine that is being operated. The driving of a heading into and through the center of a barrier pillar would hardly conform to the requirements of the state mining law, which requires a solid pillar of coal as a protection against water and gas proceeding from the abandoned workings of adjoining mines. We shall be glad to hear from any of our readers who may have some practical thoughts and ideas along the line of conserving waste mine gases, which we all admit is a valuable field for investigation.—Editor.]

Mine Cars

Letter No. 1—In his recent article reviewing the anthracite industry for the past year, *Coal Age*, Jan. 26, p. 191, H. M. Crankshaw discusses certain improvements that have been accomplished in the modernization of the industry during that time. Concerning mine cars, he suggests that it is the logical thing to replace cars having antiquated stiff bearings by cars with roller bearings of a good modern design.

Judging from the extensive research work and dynamometer tests made within recent years, the results of which have been widely published in mining literature, there cannot be the slightest doubt about the truth of such a statement, as well as regarding the considerable saving effected in the total cost of haulage resulting from the use of easy running roller-bearing cars. It is self-evident, that, in comparing costs, two mines of about the same size should be selected, one for each type of rolling stock. Each mine should be laid out to best suit the particular kind of running gear in use. When, however, Mr. Crankshaw states that "it does not pay to mix roller-bearing cars with other rolling stock," I must disagree with him.

Inasmuch as it has been proven that roller-bearing cars are the least expensive in the end, it seems to me to be in the interest of any coal operator to change over his present equipment as fast as they come through the repair shop, where they have been sent owing to breakdowns or natural deterioration. It goes without saying that, during this changing-over period, the two types of cars will become mixed, more or less, but this period will be limited to a few months or a few years depending on the size of the mine and the facilities for such work. Coal companies having several mines in operation are solving this problem by starting to equip one mine at a time, throughout, with roller-bearing cars using up the remaining rolling stock in their other mines. In short, I do not see why a coal company should penalize itself forever, on account of a temporary inconvenience due to mixed rolling stock.

In concluding, I want to mention that I have been, personally, in a number of anthracite mines using mixed rolling stock, and have found that the miners soon discover which cars are pushing easily and which do not. With the present and future difficulty to attract and keep labor in the mines, I would consider this another and quite as important a reason for the speedy weeding out of old-fashioned equipment. L. B. PAUL.

East Orange, N. J.

Coal Production and Booze

Letter No. 5—I was interested in reading the excellent letter of J. H. Tipton, *Coal Age*, Jan. 19, p. 156, regarding the effect of booze on the production of coal. Like him, I have wondered that this subject has not attracted more attention than it has, and that mining men in particular have not availed themselves of every opportunity to denounce what is quite generally admitted to be the greatest evil with which the coal-mining industry has to contend.

Many reasons might be given why the booze question has not aroused the efforts of coal-mine officials to action. It may be that they have had to contend so long with the effects of the drink habit among miners that they have become calloused to these conditions and strive to endure rather than to oppose them. My observation and reading, alike, convince me that the coal-mining industry has no greater enemy. I would say that the American people have not a greater enemy, even in the Kaiser and his allies.

No one will take me as having pro-German inclinations, however, when I say that my father and grandfather were both born in this country, which gives me a just claim to American citizenship. I have made the reference to the Kaiser merely to emphasize the fact that I believe the wide spread of the drink habit in this country is the blackest spot on American history, and no American who loves his country and is loyal will encourage the liquor traffic.

How Drink Affects Otherwise Good Workers

As an illustration of the effect of the drink habit on men, allow me to cite one instance of a fine fellow who worked for me, in the mine of which I had charge. He was a good worker; go into his place when you would you would always find him singing or whistling, and it was good music. But, when payday came, you could rest assured that he would not be in his place again as long as he had anything left with which to buy drink.

I recall one day he had a large pay coming, but did not show up at the mine in time to receive his check. He went directly to my house only to be told that I was then at another mine, paying off the men there. When he reached the place he was told that I had left a short time previous to take the train for the mines below. He hurried to the station and boarded the same train himself, but was forced to ride two miles down the track where I was waiting to take the train.

He received his check, but his troubles did not end there, as the bank refused to cash the check before it was O.K.'d by the paymaster; and to get this he was compelled to pay 25c. telephone charges. Notwithstanding he had been out two weeks before, the man did not show up again for three weeks more, making five weeks' lost time. During that period he could have mined and loaded 200 tons of coal, which shows the great loss to the country through the drink habit of one miner only in five weeks.

Observation compels me to think that one possible reason why the booze matter is not more steadily opposed by mine officials is that many of them are too anxious to indulge in the habit themselves. I wish this were not the case; but in more than one instance, I have seen men who hold responsible positions in the mine enter barrooms and drink with their men. It is unnecessary to say that this places the mine official in a very embarrassing position when men neglect their work by reason of boozing.

Effect on the Man Who Does Not Drink

The question is often asked, "Does it hurt the man who does not drink?" The answer is, Not directly, but indirectly. It destroys the social atmosphere of a place and not only makes it unfit for living but a dangerous place in which to bring up a family of children. Indirectly, it increases the cost of living, as many drinkers fail to pay their bills and the prices of goods, at the store, are forced upward to meet the deficiency.

Again, the man who works with a buddy who drinks must often lose a day when his drinking partner does not come to work. Then, for a day or so after he returns he is hardly a safe man. It is a frequent occurrence for daymen and miners, coming to the mine the day after payday, to find that the mine cannot run for lack of men. Much of the expense continues whether the mine runs or not, and the cost of production is increased. The country loses the coal and its cost to the consumer is increased. The town merchants lose, because the money that should come to them for goods goes to the saloon.

The question before us is, What can we do to rid the country of this curse and help the production of coal, which is so much needed at this time? If the coal administrator would consider this question and make some effort to cut off the supply of drink to coal-mining districts, he would accomplish a great task and one that would return him four-fold. His biggest job would then be to dispose of the coal that the mines would produce.

S. D. HAINLEY.

Osceola Mills, Penn.

Shaft vs. Slope Opening

Letter No. 4—It seems to me that the arguments advanced in Letter No. 2, *Coal Age*, Dec. 8, p. 989, and Letter No. 3, Dec. 29, p. 1110, favoring a shaft in place of a slope opening, are not convincing.

The writer of Letter No. 2 refers to the necessity of moving the pump as one objection to sinking a slope. But, the suction lift of a pump being dependent only on the vertical height of the pump above the water in the sump, disregarding the friction of the suction pipe as being nominal, it is unnecessary to move the pump in a slope oftener than in a shaft, and the difficulty of moving it is more imaginary than real.

In a shaft, the expense of providing cages, guides and other shaft equipment will nearly or quite offset the cost of rails, extra length of rope, and electric cables, pipe lines, etc., so that the difference is hardly worth considering. In regard to ventilation, if the sectional area of the slope is equal to that of the shaft, there is no appreciable difference, here also, between these two types of openings. In fact it seems to me that the various objections offered are hardly realized in actual practice.

Hoisting on Steep Slopes

The writer of Letter No. 3 objects to a slope having an inclination greater than 15 deg., or 27 per cent. grade. I would draw his attention to the fact that there are numerous slopes, in various parts of the country, having a grade of 30 deg. or more, and these are operated with perfect satisfaction. Simple devices are employed to prevent coal rolling off the cars in hoisting. These devices do not interfere with the loading or dumping of the cars. It is worthy of note that a slope can be sunk on a uniform grade, which will permit of a steady haul and reduce the tendency of coal to fall off the cars. My preference would be, in this case, to sink a 30-deg. slope whose length would be $118 \div \sin 30^\circ = 118 \div 0.5 =$ 236 ft., instead of the 437-ft. slope mentioned, having an inclination of 15 degrees.

Assuming, as suggested in this letter, there are from 18 to 29 ft., or double that amount of gravel, sand or other soft strata that must be passed through before the coal is reached, it is not clear to my mind why this would present any greater difficulty in the sinking of a slope than in sinking a shaft. When sinking a slope through such strata, forepoles can be used and good timber frames placed in position, until solid formation is reached. In the case of a shaft, there is more difficulty in keeping the alignment when passing through such strata than is found in sinking a slope.

It is true, however, that if the ground to be passed through is mostly bad, the upkeep of a slope will be more expensive than that of a shaft. Otherwise, I would favor a slope opening in the case mentioned, for the reason that the extra cost of timbering a shaft, constructing the headframe and supplying other equipment not needed in a slope will, I believe, more than offset the extra length of slope to be driven.

Comparison of Shaft and Slope Hoists

The following brief comparison between the capacity of a slope and a shaft, for hoisting coal, would seem to favor the former type of opening: For example, assuming a 30-deg. slope, where three 1½-ton cars are hoisted every two minutes, the output is 135 tons per hour, or 1080 tons in an eight-hour shift. This estimate makes a liberal allowance for the time of hoisting a single trip and returning the empties to the foot of the slope where a loaded trip is waiting to be hoisted. At the slope bottom, the track should be arranged so that the empties will run toward the mine while the loads gravitate toward the slope bottom.

When hoisting in a shaft, a motorman and a helper could handle a fair output and handle, say a 15-car trip on a half-mile haul in 20 min., running at a speed of 6 miles per hour and making due allowance for switch-

ing and starting and stopping each trip. This would represent an output of three trips, or 45 cars, making 67.5 tons per hour, or 540 tons in an eight-hour shift. To equal the capacity of the slope, in this case, it would be necessary to hoist two cars at a time in a shaft.

If rapid development is required, a single track slope can be sunk first; and this can be widened from the bottom up, as the mine is being developed, without interfering with the hoisting of coal. Surface arrangements, in either style of opening, must be largely governed by local conditions. One plan that has worked well in hoisting from a slope is to haul the loaded trip up an incline to a dumping floor above the mouth of the slope, where the entire trip is dumped in a single operation by means of a rotary dump. This plan cannot be used in a shaft opening.

Where the railroad runs close to the shaft, and the latter is equipped with self-dumping cages and coal conveyors, the shaft has much to recommend it, in respect to economy of handling coal at the surface. I agree with the suggestion made in this letter that the advice of a competent engineer should be sought in deciding these matters.

In considering a slope opening, it is important to provide against the slipping of the track down the slope. This must be avoided by anchoring the track by the use of long ties or cross-timbers at frequent intervals. These are hitched into the strata on each side of the track. To give rigidity to the track, 30- or 40-lb. iron must be used, fishplated and spiked well to the ties. When the track is well ballasted there is no reason why it should not last for years with little attention.

———, Wash. MINE BOSS.

Answering Examination Questions

Letter No. 2—Referring to the letter of Joseph A. Greaves, *Coal Age*, Jan. 19, p. 158, I want to say that his idea of arranging a key to the mining law, so as to fix in the memory all the requirements of the law in respect to different operations performed in the mine, is good. It is an effective, yet simple, method of memorizing what the mine boss should know and which he is apt to forget when attending to his many duties in the mine.

In general, it may be said that the state mining law covers practically every point relating to the health and safety of mine employees, and it is these points that are mostly emphasized and treated in the examination of candidates for mining positions.

EMPHASIZING IMPORTANT POINTS IN MINE LAW

I assume that Mr. Greaves has observed that there is much duplication in the several articles of the mining law to which he has referred, but this fact merely emphasizes the importance of those points and the repetition in the law is not a bad feature, since too much emphasis cannot be placed on the necessity of being thoroughly familiar with every requirement of the law, especially those on which the safety and efficiency of coal mining depends. It is well to remember, however, that the method of securing and retaining this information should not be so mechanical that it will tend to lessen the exercise of one's faculties for thinking and using his best judgment.

Therefore, while our answers to examination questions should conform to the requirements of the mining law, they should also partake of a practical nature that will show the examining board that a candidate has a practical knowledge of mining beyond what he has studied and read. Let me say, here, that the questions themselves should be such as to call forth a candidate's practical knowledge of the operation of the mine in respect to safety and economy.

IMPORTANCE OF PENALTY ENACTMENTS

There appears to be one point that Mr. Greaves has seemingly overlooked in his analysis of mining law. I refer to the penalties enacted for the violation of its requirements. It seems to me to be very important that a man should know what the penalty is for the violation of any section of the law. For example, there is a minimum and a maximum fine or imprisonment, or both, for the violation of any of the requirements in respect to blasting in coal mines.

A knowledge of these penalties would command more respect for the law and decrease the dangerous practices of miners that frequently exact such a tremendous toll on life and health. A hunter usually knows the penalty for violation of the game laws and, in the same manner, every miner should know the penalty for violation of the mining laws. W. H. NOONE.

Thomas, W. Va.

Clearing a Heading of Gas

Letter No. 7—I have been reading the letters on this subject, and the suggestion of hanging a canvas in the return airway 90 ft. back from the face reminds me of an attempt I once made to block the gas, at the face of a heading, and prevent its coming out into the airway, long enough to allow a machine to cut the coal in the last room.

For this purpose, I hung the canvas as close to the face of the heading as I could approach. After waiting some time, I found that the canvas did little good where it was, as the gas was still too strong to permit the machine to operate in the room. Therefore, I abandoned the idea and determined to clear out the gas in the usual manner, by extending a line of brattice from the last crosscut to the face, along the rib of the heading.

This had the desired effect and the gas was quickly moved, even before I had completed the extension of the brattice to the face, as it gave the air a straight shoot to the gas and swept it from the face.

Harrisburg, Ill. MINE EXAMINER.

Correction

Kindly permit me to call the attention of *Coal Age* to a misstatement in the article entitled "Illinois and Missouri Coal Fields," Jan. 12, p. 72. The last sentence in the second paragraph of this article should read as follows:

"But *below* that level, within the Illinois basin, about 1000 ft. of strata were *previously* deposited, which were entirely separated from and have no connection with the Missouri basin." GILBERT H. CADY

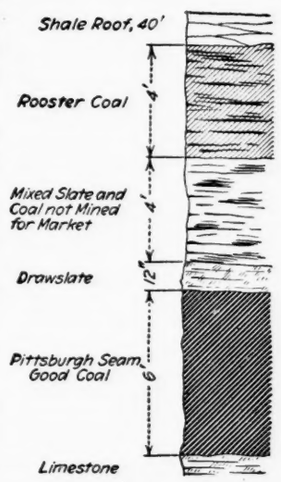
Urbana, Ill. State Geological Survey

INQUIRIES OF GENERAL INTEREST

"Rooster Coal," Pittsburgh No. 8 Seam

I am seeking information that I know many readers of *Coal Age* can give, in regard to working what is so widely known as the "rooster coal," which occurs in connection with and overlying the Pittsburgh No. 8 seam in many districts. What I desire, particularly, are the answers to certain questions, which I hope will be submitted through *Coal Age* to readers who have had practical experience in the working of this seam. The questions are as follows:

1. Is it practical to work the rooster coal with rooms 24 ft. wide?
2. If this is considered practicable, explain how the rooms should be ventilated.
3. What percentage of this seam is usually recovered, in the present system of mining?
4. What steps should be taken to insure safety and comply with the requirements of the Pennsylvania Mining Law, in the working of the rooster coal?



SECTION OF PITTSBURGH SEAM

The accompanying figure shows a section of the seam as it occurs in the locality that I have in mind. As here shown, the lower 6-ft. seam of coal, resting on a limestone bottom, is overlaid with 1 ft. of drawslate, above which is 4 ft. of mixed slate and coal, which is of too poor quality to be mined for market use, but makes a fair roof. Overlying this stratum is 4 ft. of rooster coal, with 40 ft. of good shale roof.

Any information regarding the most practical and economical method of working this seam will be greatly appreciated. MINE FOREMAN.

Cumberland, Md.

Coal Age gladly submits this proposition to its practical readers who have had experience in working the Pittsburgh seam, and hopes that they will furnish this correspondent with the answers to the questions asked, as may be suggested by their own experience.

In general, it may be stated that the rooster coal partakes of the nature of a high-grade bony coal that, under ordinary normal mining conditions, is not considered marketable. At the present time, however, when the demand for coal has so greatly exceeded the available supply, it is quite probable that much of this inferior coal will be marketed and used. We shall be glad if readers will give their opinions frankly, based on their experience in respect to the utility of rooster coal at the present time, and explain their methods of working the two seams shown in the accompanying section, assuming, for argument, that the seam is overlaid with, say 200 ft. of cover.

Answers to this inquiry should be accompanied with sketches showing the proposed plan of working. The order of working the two seams should be plainly stated and the difficulties to be encountered and overcome fully explained. These factors can only be correctly judged and provided for by those who have had experience under similar conditions and are familiar with the peculiar character of the Pittsburgh seam and the overlying formations.

Divining Coal Beneath the Surface

Kindly state whether it is possible, by any means, to detect the presence of underlying coal seams that do not outcrop on the surface, except by drilling or sinking prospect holes. I do not refer, now, to observing any physical conditions that might suggest the presence of coal seams because of a geological knowledge that discloses the coal formations; but I have understood that there is a device, the use of which will enable one to discover the presence of coal or other minerals lying beneath the ground. If there is such a device, I am interested in knowing where it can be procured.

Niagara Falls, N. Y. PROSPECTOR.

There is no such device as that referred to by this correspondent. The presence of underlying coal seams must be ascertained either by an intimate knowledge of the geological formations and a close study of the local conditions, or by sinking prospect holes or drilling.

This inquiry reminds one of the old "divining rod," which was formerly used to detect the presence of water beneath the surface, for the purpose of ascertaining the best location for sinking a well for water supply. The divining rod consisted of a simple hazel twig, which was held lightly in his hand, by the prospector, as he walked over the surface.

It was assumed that where the twig inclined downward water could be found beneath the ground, and many wells have been located and sunk for water depending on this belief. The method, however, did not always prove infallible, and the failures that occurred have caused faith in the hazel twig as a divining rod to wane, although some can still be found, in the western wilds, whose faith remains unshaken.

For the detection of some minerals, particularly iron, nickel, or other magnetic substances, the dipping needle is frequently used. This consists of a magnetic needle mounted in a vertical plane. The prospector holds the instrument in his hand, as he walks over the surface, and observes closely its deflection in certain localities where the ore may lie nearer to the surface.

EXAMINATION QUESTIONS

Alabama First-Class Examination, Birmingham, Jan. 21-24, 1918

(*Selected Questions*)

Ques.—If you had charge of a mine, with 10 in. of drawslate over the coal, what instructions would you give your men in regard to timbering?

Ans.—When mining coal under a 10-in. drawslate, posts should be set not more than 4 ft. apart, or less where the slate has a tendency to fall between the timbers. In driving rooms 7 or 8 yd. in width, the miner should be instructed to keep two rows of posts behind him, the rows to be not more than 4 ft. apart and the first row not more than 6 ft. from the face of the coal. The posts in the two rows should be staggered; that is to say, those in one row should not be set behind those in the preceding row, but halfway between them. As the face is advanced, the posts in the back row must be drawn and the slate allowed to fall. These posts are then reset nearer to the face of the coal. Where the coal is cut by machines, it may be necessary to draw and reset each post, at the face, in order to allow the machine to work.

Ques.—What is the rubbing surface in an airway 4 ft. high, 9 ft. wide and 1000 ft. long?

Ans.—The perimeter of this airway is $2(4 + 9) = 26$ ft. The rubbing surface is, therefore, $1000 \times 26 = 26{,}000$ square feet.

Ques.—What dangers arise from lack of judgment in placing shots?

Ans.—When a shot is improperly placed, the charge of powder is unable to perform the work expected, and either blows the tamping from the hole or cracks the coal without throwing it down. In either case, the force of the explosion is expended largely on the air. When a shot blows its tamping it is called a "blownout shot"; but if the shot merely cracks the coal without breaking it down, there results what is called a "windy shot." In either case, flame at a high temperature is projected from the hole or through the crevices made in the coal. Under these conditions, a large quantity of fine dust will be blown into the air by the force of the blast. This dust, acted upon by the flame of the explosion, is converted into gas so rapidly that a dust explosion is produced.

Ques.—What conditions would guide you in determining the width of headings and rooms?

Ans.—The width of headings is determined not only by the practical requirements of the mine in respect to haulage, drainage and ventilation; but, also, by the depth of cover, thickness and inclination of the seam, character of the roof, floor and coal, and the length of time the heading must be kept open.

The width of rooms is determined by the depth of cover, character of the roof, floor and coal, the system of mining employed, and the time the rooms must be kept open. The width of the room must also bear a fixed relation to the width of pillar, both being determined by the conditions just named.

Ques.—What percentage of relative humidity would you consider necessary in a dry and dusty mine?

Ans.—It would be difficult to maintain a constant percentage of moisture, in the mine air, where the mine is dry and dusty, since the relative humidity or percentage of moisture in the air depends not only on the weight of moisture contained in a cubic foot of air but, likewise, on the temperature of the air. The weight of moisture, per cubic foot of air carried into the mine, will depend on the degree of humidity and the intake temperature, both of which are variable.

Where artificial means are used to maintain the humidity of the air current, in a mine, better results are obtained; but the moisture is alternately deposited and absorbed, at intervals, in the passage of the current through the mines. Mine air is most healthful and work is less exhausting when the relative humidity is from 60 to 70 deg. On the other hand, it may be assumed that less danger will arise from the presence of dust when mine air is fully saturated. Such a condition, however, is rare, in a dry and dusty mine.

Ques.—What quantity of air will be necessary to ventilate a mine in which 200 men and 10 mules are employed?

Ans.—Sec. 40 of the Mining Law of Alabama requires the operator or superintendent of a coal mine to maintain "ample means of ventilation for the circulation of air . . . to an extent that will dilute, carry off and render harmless the noxious and explosive gases generated in the mine." The law requires not less than 100 cu.ft. per min. per man and 500 cu.ft. per mule or horse, which would mean, in this case, the circulation of $200 \times 100 + 10 \times 500 = 25{,}000$ cu.ft. of air per minute. As much more may be required as the condition of the mine with respect to gas may demand.

Ques.—What are the dangers due to shotfiring, in gaseous mines? What precautions are necessary to prevent the same?

Ans.—In the firing of shots, in gaseous mines, the danger always exists of the possible ignition of the gas accumulated at the face or issuing from the coal as a feeder. To avoid danger, in the former case, no shots should be fired before the place is examined for gas and found to be safe. Care should then be taken not to overcharge the hole, and good judgment should be used in placing and tamping the shot, to avoid a blownout or windy shot. All accumulations of dust must be removed from the working face and the place thoroughly sprinkled immediately before firing. Not more than one shot should be fired in a close place, at one time. As a further precaution, all holes should be examined, charged, tamped and fired by competent shotfirers authorized to refuse to fire any shots that, in their judgment, are unsafe.

COAL AND COKE NEWS

Harrisburg, Penn.

In response to a questionnaire sent out by Fuel Administrator H. A. Garfield, the fuel administrator for the Pittsburgh district has estimated the amount of coal saved by the five-day shutdown of industry and succeeding "heatless Mondays." About 500,000 tons of coal have been saved so far in the district.

The unprecedented congestion on the Reading Ry. system took into the hard-coal region President Dice, General Manager F. M. Falck, Vice President Ewing, and other high officials of the company. A thorough investigation of railroad conditions was made all along the road, with the result that the greatest shakeup in the history of the Reading Railway Co. came. Superintendents were ousted, trainmasters were changed from one place to another, and from out of the maze of shakeups came the placing of practical railroad men—men of the "old school," as railroaders put it—at the reins. The effect of this old blood thus injected was evident in every vein of Reading transportation service. Coal began to move with a regularity that made possible a more thorough and familiar delivery to collieries of empty cars and the prompt removal of loaded cars.

On one of the visits of the officials of the Reading Railway Co. thirty cars of coal were discovered snowbound at a siding of the Shamokin division. Inquiry revealed that these same thirty cars had been standing on the siding for almost a month, without any effort made to convey them to the main line for transportation to their scheduled destination. This was one of the conditions that brought about the change of railroad officials and the elevation of the old and experienced practical railroaders to places until recently occupied by civil engineers.

To combat the practice of operators who ship coal of such poor quality that, experience, shows, it cannot be burned, Mr. Potter issued orders to county fuel administrators in the state to authorize the railroads to stop furnishing cars to every mine owner who failed to live up to the ruling that only standard coal was to be shipped.

The first case reported of seizure of coal was made by Baird Halberstadt, fuel administrator of Schuylkill County, when John Conway, inspector for that district, on Feb. 8 seized a quantity of so-called coal being placed on cars at Pioneer Island for shipment to New York and Philadelphia ports. The stuff, it is alleged, consisted largely of yellow dirt, slate and slag with small percentage of anything combustible. Tons of the stuff that was already loaded were ordered to be unloaded. A number of concerns in this section who have, it is alleged, been imposing on the public will be accorded similar treatment.

To put a stop to the mixture of 75 per cent. of buckwheat with pea coal, and about the same proportion of pea with chestnut, Mr. Potter on Feb. 9 issued an order to all operators that coal must be standardized strictly according to prepared sizes before shipment, on the threat of being prosecuted under the Lever act, which provides a $5000 fine or jail sentence.

Governor Brumbaugh has written a letter to the President of the United States asking that he prohibit the delivery of coal to breweries. In his letter to President Wilson, the Governor says:

"Pennsylvania produces substantially half the coal of the nation. We are now in great distress because of the lack of fuel for the homes and industries and institutions of the people of this commonwealth. The closing of our industries on defined days has brought slight relief and continued distress. Our working people have not the fuel to keep themselves and their loved ones warm. Our great industries, so essential to the well-being of our people, are hampered and hindered in their operations. Even our miners are without fuel at their homes and are working only part time because sufficient cars are not delivered at the mines to receive the output. Our schools are in many places closed for the lack of heat. Many of our churches cannot be used for divine services because there is no available coal to heat them. The outlook is most disquieting. The people of Pennsylvania are loyal and steadfast to national purposes and have always been so.

"But, Mr. President, in the name of our people, I beg to suggest that fuel should not be furnished to agencies that tear down and denied to agencies that build up the substantial fabric of spiritual good of productive genius in Pennsylvania. May I, therefore, suggest that you would be generally commended were you to exercise your high powers by denying coal to breweries and like concerns, and thus providing more coal for our homes, our schools, our hospitals, our churches and our industries. I appeal to you in this crisis, in these days of distress, to give thought to this matter and take such action as to you is wise. The situation is acute. The relief is needed. The remedy is with you."

Baird Halberstadt, fuel administrator for Schuylkill County, has announced the appointment of John Conway as United States Coal inspector for the county. Conway has had long experience as mine foreman and superintendent and has been instructed that no discrimination is to be shown in favor of any corporation, large or small.

It is expected this appointment will do much to correct the abuse of flooding the market with improperly prepared coal. Conway will inspect shipments from breakers, washeries, river receiving plants and culm banks as well as stocks in coal yards.

Investigation of the quality of coal shipped by anthracite operators, big and little, has brought to light such conditions as to cause the Federal Fuel Administration, through A. C. Campbell and Tudor Williams, administrators in Luzerne and Lackawanna Counties, to take summary action.

An order was issued by Mr. Campbell on Feb. 5 in behalf of the Fuel Administration that puts up the bars against any further sale of inferior and impure coal. The order, effective at once, is as follows:

"The United States Fuel Administration feels that no anthracite coal should be sold unless it has been prepared properly the customary way—that is, as it was in the beginning of the year 1914. Pursuant to instructions received, the Fuel Committee directs that you hereafter do not ship or sell any coal unless it has been prepared in the customary way, to wit: by passing the same through a breaker or a washery, so as to properly size and remove the rock, slate, dirt, and ashes from the coal. We demand that you will immediately comply with this order and send us a letter to that effect."

PENNSYLVANIA

Anthracite

Nanticoke—Anthracite collieries are threatened with a famine, and lack of water pressure is seriously hampering the production of coal. Nos. 6 and 7 collieries of the Pennsylvania Coal Co. were closed the greater part of several days because of water shortage. Other operations had low pressure and the coal output was not up to normal. Officials of the water companies declare that the situation is acute.

Scranton—Daniel Young, general superintendent of the Scranton Coal Co., suffered a fractured hip and severe bruises about the body, when caught under a fall of rock in the Capouse mine.

Wilkes-Barre—Freight congestion has seriously interfered with the supply of mining powder for local mines, and resort has been had in several cases to transfer of powder from one mine to another and use of the wrong grade of powders because the right was not available.

Sunbury—The Northumberland County Grand Jury has recommended that the county commissioners direct the assessors to increase the valuations placed on coal culm banks for taxable purposes. At the last biennial assessment the valuation of anthracite property in the county was raised from $4,500,000 to $7,000,000, by a board of mining engineers, working in conjunction with Judge Mosier, who was a mining engineer before becoming a lawyer, and the county commissioners.

Hazelton—Women cannot work at collieries except in a clerical capacity, declared officials of the United Mine Workers. This apparently settles the question raised by some operators who thought they might relieve the labor shortage by hiring females to do outside work and thus release men for employment underground. The law was quoted which states that "women cannot work in or about the mines of this commonwealth."

Mauch Chunk—What may prove to be a disastrous fire has been discovered in the No. 11 colliery of the Lehigh Coal and Navigation Co. by one of the loaders who was drawing coal from a chute. The consensus of opinion seems to be that it is from the burning mines near-by. Everything possible is being done to head off serious trouble.

Bituminous

Johnstown—It is reported that many bituminous coal mines in Pennsylvania will suspend operations around Apr. 1, when most contracts expire, unless the Government price of $2.45 a ton at the mine is increased sufficiently to give the operators a "reasonable profit," or at least sufficient to permit them to break even.

Irwin—Four hundred miners employed at the Yough shaft of the Westmoreland Coal Co. were thrown out of employment by a fire in the boiler house.

Woodville—The fire in the coal mine at the county home, which has been burning since Jan. 27, is practically under control. The fire had been eating its way through a five-foot seam of Pittsburgh coal. The entrances to the mine had been sealed and then the workings were flooded. It will be necessary to open new entries and drain out the water.

WEST VIRGINIA

Quick—The first car of coal has been shipped from the mine here, which was recently opened by Lebow Brothers, of Charleston. The operation is located on the Kanawha & West Virginia Railway.

Wheeling—A new coal-mining concern, advertising as the "W-G" Co., (probably the Whitaker-Glessner Co., of Wheeling) is sinking a shaft for a coal mine on the property now occupied by a family by the name of Cage at Elm Grove. The work has been in progress for the past three weeks. If it proves to be the local concern, the new mine will undoubtedly be joined with the other mines of the concern, which extend to Wheeling Park (one mile from Elm Grove) from the company's offices.

KENTUCKY

Lexington—Work has been begun by the H. C. Frick Coke Co. on the development of coal fields in Harlan County. It is planned to spend $9,000,000. The maximum output is expected to be 2,000,000 tons of coal a year.

OHIO

McArthur—Stratton Brothers, who own the Ballard lands in Madison township, are preparing to open the coal on this land by stripping the surface over the coal.

Bellaire—The Star Coal Co., of which W. J. Watterson is president, has taken a lease on the mine of the Brooks Run Coal Co. and has already resumed charge.

Steubenville—Copper wire by the hundreds of pounds has been stolen from the coal mines of this vicinity during the past year, the last theft of this sort endangering the lives of nearly 100 miners at the Gilchrist No. 3 mine of the West Virginia Coal Co. On Saturday, Feb. 2, with about 100 men in the mine, the wire on the big fan which supplies air for the workings

was cut mysteriously. The theft was discovered in time to hastily repair the damage, and a tragedy was thus avoided. It is believed that the culprit has been caught.

INDIANA

Brazil—Franklin-Tandy-Lowish Coal Co., operating a large mine southwest of Staunton, have announced that a larger mine would be sunk on their land in the early spring. The offices of the company are in the Davis Trust Building.

Terre Haute—The tipple of Mine No. 5 of the Jackson Hill Coal and Coke Co. was burned on Feb. 12. The fire is declared by General Manager Kolsem to have been incendiary. Coal production will be cut down about 2000 tons a day until the mine can be reopened. This was the third mine tipple in this coal district destroyed by firebugs.

ILLINOIS

Benton—Twelve men were injured in the mine of the Benton Coal Co. recently, when the engineer of a cage which was being lowered into the mine lost control of his engine. Ten of the men were taken to the hospital at Ziegler.

Duquoin—Coal has been reached in both the main and air shafts of the new coal mine belonging to the Union Colliery Co., of St. Louis, Mo. The mine is located at Dowell, Ill., a new town near Duquoin. Coal was found in the air shaft at a depth of 220 ft. and in the main shaft at slightly more than that depth. The mine is said to be second to none in Illinois in capacity. A mine tipple and an office building will be erected, as well as a hotel, store, bank and houses for 1000 people.

Lincoln—The Lincoln Mining Co., operating one of the oldest established mines in central Illinois, has decided to close its mine and to discontinue the affairs of the company. The company has been unable to extinguish a fire which has been raging in the mine since Oct. 23, 1917, although six distinct attempts involving the expenditure of considerable money have been made to put out the fire. The company was organized in 1867 and began mining operations Dec. 15, 1869. Three seams of coal were passed through before the present 5-ft. seam was struck. The business was conducted for many years under the name of Harts & Frorer, but in 1905 was incorporated under the name of the Lincoln Mining Co. The company sustained destructive fires in 1883 and 1903.

Pana—Two hundred and fifty miners who refused to work in the Pana Coal Co.'s mine here for two weeks because the washhouse was not sufficiently warm for the changing of clothing have been fined $4 each by the Federal Fuel Administration. It is understood to be the first fine of its kind in the Illinois field.

Bush—The mine and washer here of the Western Coal and Mining Co., of St. Louis, has been entirely dismantled. The tipple and machinery have been removed to the Henderson-Wallace mine at Marion, where it will be used.

Zeigler—The Ziegler mine, which has been shut down for the last few months since the explosion, has been opened up, cleaned out and is now producing coal. This mine produced between 3000 and 4000 tons per day.

West Frankfort—For the first time in the history of southern Illinois the coal mines here have arranged with their men to work seven days a week, provided cars are available. The plan is to be worked out for a period of five weeks in an effort to increase local coal production. Six large mines are affected.

Johnston City—Shaft No. 2 of the Johnston City Big Muddy Coal Co., controlled by P. H. Holland and others in Chicago, is now down to coal. It is expected that the mine will be on a producing basis some time in the early spring. It is located a mile and a half northwest of Johnston City.

Christopher—The old Moderwell mine here, which was shut down for several weeks, due to an explosion, has been opened up and is now producing.

Gillespie—A branch of the Northwestern R.R. is being built from here to the site of Mine No. 4 of the Superior Coal Co., which is to be the largest mine in the world, employing 2500 men and with a hoisting capacity of 8000 tons a day. The Superior company already has three mines here, one of which, No. 3, holds the world's record for hoisting 5550 tons in eight hours. The three mines employ 2500 men and the biweekly distribution of wages is about $125,000. The right of way for the Northwestern spur to the new mine was furnished by Gillespie business men.

Stonington—Following the gas explosion in the Stonington mine, which killed three miners, threats were made by friends of the victims that they would blow up the mine. The mine was idle one day because the men feared to go down, although half of them appeared at the shaft.

OKLAHOMA

Tulsa—Coal mines of Tulsa County, Oklahoma, are working at full capacity, both night and day, in an effort to meet emergency orders. The daily consumption of coal in and about Tulsa has been greatly increased within the last few weeks, due to the fact that many large industries that have been using natural gas for fuel are turning to coal because of the inadequacy of the gas supply in severe weather. The Cosden Oil Refinery, the largest plant of the kind in the world, has installed 110 large coal burners under its boilers and will consume 2500 tons of Dawson coal daily. New mines are being opened in Tulsa County, and it is said that the output of this county will be more than trebled in a few months. Practically all coal mined in Tulsa County is being used in Oklahoma.

Personals

S. A. Carson has sold his holdings in the Southern Connellsville Coal Co., of Uniontown, Penn., and has resigned as director and general manager. He will devote his time to other interests.

Frederick W. Bell, formerly superintendent of the Bessie mines, property of the Sloss-Sheffield Steel and Iron Co., of Birmingham, Ala., is now general manager of the Debordelaben Coal Co., of the same place.

Edmund Ewing, who for the past year has been safety mine inspector for the Alabama Coal Operators Association, has accepted a position with the Sloss-Sheffield Steel and Iron Co., of Birmingham, Ala., as superintendent of the Bessie mines.

John Rollo, who has been general manager of the Sunnyside Coal Co. at Herrin, Ill., for eighteen years, has resigned and is succeeded by John Goalby, former mine manager. The local union tendered the new superintendent a banquet and presented him with a diamond ring valued at $175.

C. H. Weiser has resigned as secretary of the St. Louis Fuel Committee as a result of criticism by State Administrator Crossley of Weiser's action in lifting the early-closing order the night before the time fixed by Crossley. Weiser's explanation was that it was done at the request of the Chamber of Commerce in compliment to visiting merchants. His successor has not been named.

A. H. Storrs, formerly a consulting engineer, of Scranton, Penn., has accepted the position of secretary of the War Committee of the Technical Societies of the Naval Consulting Board, his office being in Room 521, 15 Park Row, New York City. This war committee receives communications of inventors of war devices, sifts them and passes them on to subcommittees and committees of the various technical societies. When they are approved, they are reconsidered by the Naval Consulting Board.

John J. Shannon, for the past few years general superintendent of the Woodward Iron Co. furnaces at Birmingham, Ala., has been promoted to the position of general manager in charge of operations. For 42 years Mr. Shannon has been connected with furnace work in the Birmingham District, being first with the Tennessee Coal, Iron and Railroad Co., then the Sloss-Sheffield Steel and Iron Co. He was also connected with the Alabama Steel and Wire Co., at Gadsden, Ala., prior to his coming to the Woodward Iron Co.

Edward J. Newbaker, general superintendent of the Lehigh and Wilkes-Barre Coal Co. at Wilkes-Barre, has tendered his resignation to take effect Mar. 1, at which time he will enter the service of the Berwind-White Coal Mining Company, in the capacity of assistant general manager. He will be located at the headquarters of the company in the Commercial Trust Building, Philadelphia. Mr. Newbaker has been in the service of the Lehigh & Wilkes-Barre Coal Co. for the last 20 years, his first employment being on the engineering corps in the Honey Brook Division, from which position he was advanced to division engineer, and later to the position of division superintendent, which capacity he occupied until six years ago, when he was made superintendent of the company's operations.

Obituary

Daniel O'Hara, aged 85, a retired coal operator, died at his home in Washington, Penn., on Feb. 4.

Thomas M. Brewster, president of Brewster & Son, coal and lumber dealers of Ridgefield Park, N. J., died suddenly at Jacksonville, Fla., on Feb. 9.

Jenkin R. Daniels, mine foreman for the Consolidation Coal Co. at Hoffman, Md., died on Feb. 5 after an illness of one year. Mr. Daniels was born in Wales, coming to this country in his youth. He worked for a short period in the anthracite region at Scranton, Penn. He had been mine foreman at Hoffman for five years.

Foreign News

Vancouver, B. C.—Three hundred and fifty miners, said to have been mostly Germans, Austrians and Poles, attempted to wreck the Rosedale mine in the Calgary district on Feb. 2. To drive them off the police had to turn a machine gun on them. The mine is nonunion.

Sydney Mines, N. S. — On Feb. 2 the mayor and town council of Sydney mines petitioned the prime minister of Canada, the premier of Nova Scotia and the controller of Canada to compel the Nova Scotia Steel and Coal Co. and the Dominion Coal Co. to exchange submarine coal holdings on opposing sides of Sydney harbor, so that the operation of the mines of both concerns may be facilitated and the thicker seams in larger measures be available for operation.

Winnipeg, Manitoba, Can.—The chief inspector of coal mines in Alberta, John T. Stirling, on Feb. 4 advocated an embargo on United States coal for all points west of Winnipeg. He said that Alberta can easily furnish all the coal needed for that area. The preference for Pennsylvania coal he declares to be largely the outcome of habit.

Edmonton, Alta.—According to figures compiled by J. L. Sterling, of the Mines Branch of the Public Works Department, Alberta, the total output of coal for that province during 1917 was as follows: Lignite, 2,637,829 tons; bituminous, 2,206,868 tons; anthracite, 118,718 tons, and briquets, 93,818 tons. There were also 31,630 tons of coke burned. The figures for 1916 were lignite, 2,172,801 tons; bituminous, 2,335,259 tons; anthracite, 140,544 tons; briquets, 107,959 tons; coke, 41,950 tons. The total number of men employed in the coal mining industry was 9812 in 1917, as compared with 8599 in 1916.

Industrial News

Ironton, Ohio—The Ironton Engine Co. announces that F. C. Tomlinson has been elected as treasurer of the company. He assumed his duties on Dec. 1, 1917. H. A. Marting is president.

Wilton, Ky.—The Corum-Parker Coal Co., of Wilton, has filed notice of dissolution, stating that the corporation is winding up its existence. The notice is signed by J. L. Corum as president.

Pikeville, Ky.—The Keel Coal Co. has completed its organization plans, and will inaugurate operations at an early date for the development of 200 acres of coal lands recently acquired. J. L. Morgan is president and manager; D. T. Keel is vice president, and J. F. Pauly is secretary-treasurer.

Snyder, Tex.—A vein of good grade bituminous coal, 18 in. in thickness, was struck at a depth of 150 ft. in Scurry County, six miles west of here. A company is being organized and plans are being made for developing the property, for it is believed that a paying coal mine can be developed.

St. Louis, Mo.—Tabulations made by W. I. Jones, traffic manager of the St. Louis Fuel Committee, show that most of the coal delivered by the committee in the past five weeks to supply essential industries was taken from the railroads. The Missouri Pacific turned over 151 cars and the Frisco 111 cars in January.

Columbus, Ohio—At the annual stockholders' meeting of the Hocking Valley Products Co., operators and jobbers of coal, S. L. Chamberlaine, of New York, was reëlected president; Sidney S. Schuyler, vice president, and Frank J. Shaffner was elected secretary. Norbert Heinsheimer was elected assistant secretary-treasurer.

Columbus, Ohio—The Columbus Shippers Terminal Pool Association, which has now been in operation for about five weeks, is performing good service in the distribution of coal to the needy consumers. The pool has been handling on the average of about 80 cars daily. For the period covered from Jan. 5 to Jan. 31, the pool handled 535 cars of coal.

Columbus, Ohio—City Purchasing Agent Louis Guthke declared it seems practically impossible to buy coal for the Columbus municipal coal yard, recently created by council for relief of domestic consumers. Service Director Borden more than a week ago placed an order with Guthke for two car loads of lump coal, to be distributed in bushel lots from city firehouses, at cost, to consumers.

Columbus, Ohio—Governor Cox of Ohio called on Railroad Director General McAdoo last week in an effort to get more cars for Ohio mines. The governor was fortified with statistics secured from the Ohio Utilities Commission and from operators and miners. He had a pleasant talk with Mr. McAdoo and claims to have received some promises of a better car supply for Ohio mines.

Louisville, Ky.—Losses to river coal companies as a result of heavy running ice and gorges in the Ohio, Kentucky and other rivers of the state have been rather heavy, hundreds of tons of coal having been sunk, and many boats and barges. On the Kentucky River the flood carried away Lock No. 14, which has since resulted in stages too low for bringing coal out from the mines at Beattyville.

Columbus, Ohio—County Fuel Administrator Young has made an arrangement with several Hocking Valley operators to receive the output of several mines to supply the fuel needs of Columbus and Franklin county. As a result of this arrangement 72 cars of coal arrived within 24 hours after the plan was completed. Special attention will be given to the coal trains supplying Columbus.

Columbus, Ohio—The Maynard Coal Co. of this city, has purchased the coal docks at Duluth owned by the Hocking Valley R.R. and operated by the Boston Coal Dock and Wharf Co. The Maynard Company a few months ago purchased the Connors Point Dock at Superior, and will now be able to handle 1,000,000 tons of coal a year, to be supplied by Ohio, Kentucky and West Virginia mines.

Covington, Ky.—The grand jury reporting to the United States District Court here returned 61 indictments against coal operators in central and eastern Kentucky, charging violations of the executive order providing for prices of coal at the mines. The indictments resulted from investigations by special agents of the Fuel Administration, and these investigations are still under way, it is understood.

East Liverpool, Ohio—A model mining town is to be established at West Point, 11 miles north of here on the Youngstown & Ohio River R.R., by J. L. Francis, of this city, whose headquarters are at Salem. The company has over 1000 acres of coal, and is now producing at the rate of about 1000 tons daily. This coal property is the largest that has ever been opened in this part of Columbiana County.

Sayreton, Ala.—The Roberts & Schaefer Co., engineers and contractors, Chicago, who are building the extensive fireproof tipple and coal washery for the Republic Iron and Steel Co. at Risco, Ala., have been awarded another contract by this company to rebuild the tipple and washery recently destroyed by fire at Sayreton. The new plant will be of fireproof construction and will cost approximately $200,000.

St. Louis, Mo.—The cost of the coal "input" is twice that of previous years. In former winters the universal price paid for putting the coal in the cellar was 1c. a bushel and the laborers kept it all. Now it is 2c. a bushel. Ten cents of the increase goes to the man who does the work and 15c. to the dealer. The dealers say the 15c. a ton covers the cost of bags, shovels, chutes and wheelbarrows furnished by them to the laborers.

Kansas City, Mo.—The Mayor and other city officials held a meeting here this week and appointed a delegation to go to Washington with Fuel Administrator Crossley of Missouri to protest to Fuel Administrator Garfield against the creating of zones that will prevent Kansas City and adjacent territory from getting Illinois coal. This privation, it is contended, will work a hardship that cannot be overcome by securing coal from other fields and the outlook is extremely grave.

Columbus, Ohio—Columbus coal men took a prominent part in the campaign in Columbus to secure $3,000,000 as a war chest to take care of all war relief work during the present year. A special soliciting team of coal men was named, of which G. A. Davis, of the Hitt-Davis Coal Co., is captain. Other members of the team are T. C. Collins, S. L. Comley, Paul Spence, George C. Weir, R. J. Framer, W. P. Plant, R. W. Rittenhouse, George F. Schwartz, C. M. Anderson and H. H. Leukhart.

Louisville, Ky.—The January Grand Jury in retiring recommended to the city that the latter purchase and operate its own coal mine for supplying city institutions with coal. The Board of Works announced later that under no consideration would the city own its own mine, as it would cost too much to operate. J. M. Thompson, a mine operator of Central City, Ky., wrote the Board of Works, directly following the statement made by the Grand Jury, offering to sell a mine, but the offer was declined.

Murphysboro, Ill.—Railroad trainmen here complain that crews are needlessly delayed along the lines in what appears to them an effort on the part of the roads to break the prevailing eight-hour service law. A number of trainmen say that such delays are frequent and apparently without real cause. This is prevalent on the M. & O. in particular, and it is understood to prevail on nearly all roads in southern Illinois. This is one reason why coal has not been transported from the mines to the market.

Whitesburg, Ky.—It has been announced that the Garey Coal Co., of Lexington, Ky., recently organized, capital $50,000, will start developments of coal properties on the Louisville & Nashville branch into Perry County. The Elkhorn Block Coal Co., composed of Tennessee people, is at work on a coal development project below Jenkins, Ky., on the Baltimore & Ohio R.R., where the Reuben Anderson coal property is being developed. It is said that a new mining town will be built here and operations carried on at a large scale.

Columbus, Ohio—John H. Winders, as receiver for the Sunday Creek Coal Co., has filed a receipt in the common pleas court showing the claims against that company. The claims aggregate more than a half million dollars. The largest, $228,000, is held by the New York Coal Co., on royalty claims. Similar claims of $88,000 and $25,000 are held respectively by the Imperial Coal Co. and the estate of J. B. Tompkins. The Central Trust Company of New York holds a claim of $153,000 against collateral trust bonds. Practically all of these claims, except that of the trust company, are in dispute.

Columbus, Ohio—Bids will be opened Feb. 25 by George A. Borden, president of the board of purchase, and Louis K. Guthke for approximately 35,000 tons of coal for the various city departments. The advertisements contain the usual provisions such as deposits of 50 per cent. of the amount of the contract. The amounts of coal required are 5800 tons of mine-run or nut, pea and slack for the garbage-reduction plant; 12,500 tons of nut, pea and slack for the waterworks department; 15,000 tons of nut, pea and slack for the municipal light plant; 900 tons of lump for the workhouse and several smaller amounts.

Cincinnati, Ohio—In order to distribute coal to consumers in the congested districts of the city who were unable to secure ton lots, the city of Cincinnati has adopted the plan of placing coal at the fire-engine houses, where small consumers can secure bushel lots for emergency needs. This plan was resorted to in the severe weather during the early part of last week, and proved useful in getting to people who would otherwise have been compelled to go without. Several large retail dealers furnished trucks to haul the coal to the stations. Most of this coal was sold at 30c. a bushel, although some was distributed free of charge to needy families.

Cincinnati, Ohio—At a meeting held in Cincinnati on Feb. 4, attended by coal operators, rail officials and members of the Fuel Administration, plans for complete coöperation in forwarding and distributing coal, in order that essential needs might be supplied, were thoroughly discussed, and assurance was given that public utilities, at least, would be supplied with coal, in order to avert threatened widespread distress. The meeting secured immediate touch with the Fuel Administration's Washington headquarters by telephone, and was assured that Cincinnati would be supplied with as much coal as was necessary to meet pressing needs.

Youngstown, Ohio—The Republic Iron and Steel Co. has confirmed the purchase of the Bessemer Coal and Coke Co.'s coal properties in Pennslyvania, consisting of about 3000 acres of coking coal, with two shaft openings and a capacity of about 2000 tons a day, and has been operating them since Jan. 1 through the Woodside Coke Co., a subsidiary company. J. W. Deetrick, vice president of the Republic company, in charge of its fuel operations, is handling the business. The properties are located in Allegheny County, Pennsylvania, and constitute about one-third of the company's coal production, which, at full capacity, give it all of the 6000 tons a day required in its extensive steel operations.

Louisville, Ky.—A special Federal grand jury at Covington, Ky., on Feb. 2 returned indictments against 60 coal operators, a majority of whom are operating in eastern Kentucky sections, charging these operators with violation of the orders of the Fuel Administration, in that they are charging prices in excess of those set by the administration. Leading coal operators of Kentucky have stated that most of these indictments have been returned against the small wagon mines, which never recognize a market price at any time, and who are always a source of great trouble. Some of the larger operators are in hopes that such operators will be dealt with harshly and feel that it should be done under existing conditions.

Charleston, W. Va.—A new scale of demurrage charges has been placed in effect, beginning Feb. 10, by the West Virginia Public Service Commission, cancelling the schedule of demurrage rates placed in effect Jan. 21, and providing for 48 hours' free time for loading or unloading, and 24 hours on cars held for any other purpose permitted by the tariff. New demurrage charges on all cars after the expiration of free time will be $3 for each of the first four days, $6 for each of the next three days, and $10 for each succeeding day. The Commission intends the new charges to expedite the movement of cars and to relieve, to that extent, the shortage of cars which continues to hamper the output of the mines.

St. Louis, Mo.—The Union Electric Light and Power Co. will hereafter operate its own coal mine under the name of the Union Colliery Co. The company has 420 acres a few miles south of Duquoin, where a main shaft and air shaft have been sunk to a thick coal vein at the depth of 225 feet. Development work is being rushed. Office buildings and tipple are being erected and contracts are let for a hotel, bank and store buildings and dwellings. The town is to be called Dowell. Between 1200 and 1500 men are to be employed. The maximum output will be 5500 tons a day. It will be operated by electricity under a contract with the Central Illinois Public Service Co. The capital stock is $250,000, all held by the Union Electric. A total expenditure of $800,000 is contemplated.

Cincinnati, Ohio—An interesting development of the coal shortage in Cincinnati is a special mission sent by the Hamilton County Fuel Administration to the coal fields of the Jackson and Wellston district, in Ohio, to secure the shipment of fuel to Cincinnati, if possible, although under normal conditions little of this coal comes to the river, most of it going north, while Cincinnati is supplied from West Virginia and eastern Kentucky. The Fuel Administration is prepared to buy for cash from Ohio operators who are in a position to forward coal to Cincinnati, and hopes to be able to secure some fuel by this means. Display advertisements in newspapers in the Ohio coal fields were used to call the attention of miners and operators alike to the distress existing in Cincinnati, and urging them to assist in relieving it by forwarding coal.

MARKET DEPARTMENT

Weekly Review

TIRED of playing the villain, the weather man early last week evidently came to the conclusion that he would essay the rôle of all-round good fellow. The result was sunshine and warmer weather. The new guise proved more than acceptable to shivering humanity, and the nation began to sit up and smile. However, it is far too soon to begin to crow, for it will be well along in the early spring before conditions in the industry will assume any semblance of stability.

The let-up in the urgent demand for domestic fuel has enabled a partial increase in the filling of industrial requirements in some quarters, though conditions in New England are far from favorable. There is still a great scarcity of steam grades, and cities in the interior are in a bad way for fuel, principally anthracite.

The use of bituminous coal has been advocated in many quarters where formerly anthracite had been burned. Some municipalities have practically suspended their smoke ordinances for the time being, the authorities evidently taking the broad viewpoint that it is better to have a little smoke and some heat rather than compel their industries to shut down and their citizens to freeze.

The effects of the recent blizzard are still being felt by the railroads, and reports from all over the country seem to emphasize the fact that transportation—or rather the lack of motive power—is still a factor which exerts a demoralizing effect on coal production. Scores of locomotives are laid up in the repair shops, and hundreds of switches which are frozen tight require attention. The work in the railroad shops should be speeded up to the highest possible pitch.

The rise in temperature has also brought to Uncle Sam's railroads the menace of floods. In many regions tracks were washed out and severe damage was done by the torrents from melting snow. Quite a few mines were flooded. With the thaw many collieries that suspended because of zero weather are now running.

The general freight situation is showing signs of improvement, and another cause for congratulation is that there are not many supply ships being delayed in New York harbor for lack of fuel.

Inadequate car supply, as ever, is the one bugaboo that the operators do not seem to be able to overcome. The United States Geological Survey shows that during the week of Jan. 26 production for the country as a whole amounted to 66.1 per cent. of capacity; and the one dominant factor limiting production is car supply. To this cause were ascribed losses amounting to 26.6 per cent. of full-time capacity, as against 7.3 per cent. for all other causes combined.

Mine workers' locals in two Ohio districts have indorsed resolutions petitioning Director General of Railroads McAdoo to suspend the operation of passenger trains one or two days each week, and to use the engines thus released for the hauling of empties to the mines.

Such a course is worth a trial. Business houses could be informed, for instance, that passenger trains would not operate on Tuesdays and Fridays of every week, and traveling men could adjust their schedules accordingly. In the event that Government officials found it necessary to reach certain points on these days, coaches could be attached to the rear end of mail trains. If sufficient warning of such a plan were given, it would meet with much less opposition than did the Fuel Administration's workless-days order.

Speaking of this order, now a thing of the past, it is universally acknowledged that though it saved little fuel, it helped considerably to relieve freight congestion. No less a person than Secretary McAdoo was against a continuance of the measure, as he feared that to adhere to the plan would seriously affect the taking up of the next Liberty Loan.

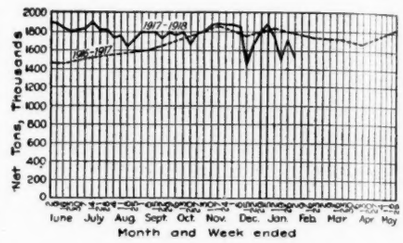
Dr. Garfield states that there will be no necessity for the shutting down of industry in the future, as he believes it possible henceforth to rely upon embargoes and the preference in the movement of food and fuel.

Operators in Washington are up in the air as regards the policy of the Fuel Administration. If that body would come out with a definite statement of its attitude on contracts, its feelings toward jobbers, and its intentions regarding prices, it would go far toward clearing up a great deal of uncertainty. Many operators are marking time insofar as the purchases of machinery and equipment are concerned, for they have no means of knowing if the new price schedule would justify any considerable investment in extensions to plant.

The few days of warm weather have brought a general feeling of optimism, a feeling it was impossible to experience with the thermometer reading zero and no fuel in sight.

COAL PRODUCTION

For the third time in two months the rate of production fell below 1,600,000 tons per working day, a drop of more than 200,000 tons as compared with the normal. The total production of bituminous coal during the week ended Feb. 2, including lignite and coal made into coke, is estimated at 9,423,000 tons. The output of



beehive coke continued to decline. Production for the week is estimated at only 446,000 tons, or 74,000 tons per working day. Shipments of anthracite were reported as 34,804 cars, as compared with 33,406 during the preceding week.

CARLOADS OF COAL AND COKE ORIGINATING ON PRINCIPAL COAL-CARRYING ROADS WEEK ENDED:

	Jan. 12	Jan. 19	Jan. 26	Feb. 2
Bituminous shipments, 121 roads	180,411	150,865*	181,471*	170,131†
Anthracite shipments, 9 roads	36,178	31,861	33,406*	34,804†
Beehive coke shipments, 4 roads	11,560	10,826	10,408*	9,161†

*Revised from last report. † Subject to revision.

Atlantic Seaboard

BOSTON

New England situation progressively worse, although less strenuous weather gives a hopeful turn. Railroads and domestic consumers have priority over manufacturers in distribution through the Fuel Administration. Cargoes of "Storrow coal" arriving are parcelled out only to consumers high on the preferred list. Hampton Roads loading improves somewhat. Several important utilities were on point of shutting down when coal arrived. Rail movement slightly easier. Anthracite extremely scarce and bituminous much sought for domestic use.

Bituminous—Throughout New England there are cases of extreme distress through lack of coal. In a city near Boston the local fuel committee asked for authority to pull down unoccupied wooden houses, there being not a ton either of anthracite or bituminous in the yard of any dealer in the place. Supplies for water and sewerage pumping stations, hospitals and other vital needs have had to be rushed out from meager emergency piles at Boston, such as the reserve supply belonging to the Navy Department. The railroads, too, have responded handsomely. The Maine Central has been kept running by fuel taken from the New Haven, and the Boston & Albany has lent coal to the Central Vermont to tide it over until boats could arrive at New London, Conn., its southern terminus.

Under the circumstances, from what limited supplies are at its disposal, the New England Fuel Administration can only furnish weekly supplies to the priorities named in Schedule A of the Garfield order of Jan. 17, to the exclusion of manufacturers of every kind. The situation of industrials is rapidly getting to an extremely acute stage, for unless fuel is forthcoming in greater volume soon, some important plants will have to close their doors.

The extreme cold of Feb. 4 and 5 again slowed up the movement of boats. Ice conditions in Nantucket Sound were unusually severe, even for this winter, and none but steamers following the outside route were

able to make Boston. Besides coal for the Navy the arrivals have only been enough to keep running the largest utilities; others have managed to scrape along by means either of emergency shipments rushed from neighboring places or through the use of buckwheat, silt and screenings. They are making their slender stocks go as far as possible.

One fortunate happening gave Boston a real thrill this week. A British collier was reported in the offing, sent here with Welsh coal for British warships when it had appeared the supply for bunkering at various ports was at least doubtful. The diversion of the ship to Boston was accomplished through the British embassy.

It still remains a remarkable fact that while there are constant reports that large plants are about to close down the number of actual shutdowns of that kind is relatively small. Of course, the pass to which things have come has roused every manufacturer to make his representation to the Fuel Administration in order to get his share of the emergency coal that is being distributed. Several instances have come to light where industrial plants are in full operation with more or less reserve supply of fuel, and in the same town there are retail dealers without a pound of coal of any kind to distribute to people for their homes. The New England Fuel Administration issued orders on Feb. 7 that local fuel committees should see to it that retailers get fuel for delivery in small lots, if necessary, by asking the state administrator to commandeer coal arriving for manufacturers in the same town.

All the receipts of bituminous for delivery to retail dealers are pooled and then distributed through orders made out by a central agency. Likewise a committee of shippers has been formed to serve in an advisory way, and generally assist in the fair distribution of what coal arrives, whether through the administration or through ordinary channels. Shippers are now consulting the fuel authorities before they attempt to distribute cargoes, and the result of this coöperation is a general improvement not only in means and methods but in the fairness of distribution.

The 300 cars Mr. Storrow was authorized to divert at the New England gateways on Jan. 31 have now practically all come through, except via Mechanicville, where movement is preëminently slow. The diversions were accomplished from consignees other than retailers, utilities and plants working 100 per cent. on Government orders. Much confusion arises over the latter classification, since there is hardly enough fuel to keep them all running more than part time. The pressure brought to bear in favor of certain of these plants is something tremendous.

Loading conditions have improved somewhat at Hampton Roads, dumping being easier, but the delayed unloading of cars is already having its effect on the volume of coal available. The improvement in dispatch is therefore likely only to be temporary, until something like an equilibrium can be established.

Anthracite—Although the movement of domestic sizes is improving slightly via Maybrook and Harlem River, the volume of coal in the hands of retail dealers throughout New England is very small. In a large number of towns and in some cities domestic consumers are forced to rely upon what meager supplies of bituminous are placed at their disposal. Practically everywhere, and especially at points near tidewater, the price of soft coal is on the same basis with anthracite, and the demand for it for domestic use is increasingly insistent.

Nearly 30 per cent. of the "anthracite" shipments coming through the rail gateways recently was culm, silt or other steam size. This is a commentary on the statistics so frequently quoted as showing the excess of shipments into New England compared with a year ago.

NEW YORK

Anthracite situation is slightly relieved owing to milder temperatures, but conditions are still serious. Bituminous released for household purposes. Fuel Administrator sends warning to business organizations. Ask that Delaware & Hudson Canal be surveyed. Vessels being supplied and situation is much easier. Car supply bad and transportation slow.

Anthracite—There has been some relief in the situation due to seasonable temperatures and the breaking up of the ice in the rivers and bay, causing a better delivery of supplies. Early this week, owing to the severe storm in the mining regions (the twenty-ninth snowstorm of this season), which tied up transportation and resulted in a falling off in production, it was possible to move coal at the Tidewater docks so as to keep ahead of receipts. However, there was not much headway gained and the situation continues to be serious, but the hope is expressed by tradesmen that unless this section of the country is again hit by a heavy snowstorm and unseasonably low temperatures, the shortage will not be so severe as it was a few weeks ago.

Reports received here the first part of this week show there was a good movement of coal toward Tidewater and that the mines have resumed work to their full capacity. More attention, it was said, would be devoted to preparation as a result of numerous complaints made to the Washington authorities. Inspectors are now at work at the breakers supervising the work of preparation and to carry out the orders of the Fuel Administration officials.

State Fuel Administrator Wiggin has written to the presidents of the Chamber of Commerce of the State of New York and the president of the Merchants' Association of the City of New York, citing defects and difficulties of the coal supply situation at this port. These, he says, call for study and thought looking toward future relief. Mr. Wiggin says the four main difficulties here are insufficient unloading facilities at the docks; inadequate storage facilities in Manhattan and Brooklyn; insufficient supply of tugs, many of which have been commandeered by the Federal Government, and insufficient coal-carrying barges to bring coal from the docks to Manhattan Island. This latter, he states, has not been an important defect this year because of the small quantity of coal, but with a normal supply will become a great factor.

The Chamber of Commerce has adopted a resolution recommending that the necessary legislation be passed authorizing a preliminary examination and survey by United States Army Engineers, for determining the advisability of restoring the Delaware & Hudson Canal, saying that it would be an important factor in relieving railroad congestion and in providing cheaper transportation rates for coal to the industrial centers of New York, New Jersey, the New England states and other points.

During the past ten days the New York market had gone through the most critical period of the entire winter. Only a moderation of weather conditions prevented a real coal famine which would have caused untold suffering and an almost general closing down of industries. Temperatures were nearly as low as in the middle of December, while heavy ice floes went far toward bringing river transportation to a standstill. Loaded barges and tugs were icebound and many remained in that condition for several days, some destined for Long Island points not being released until Monday of this week. The scarcity of anthracite became so serious that the Fuel Administrators released bituminous to private houses, apartments and hotels, ignoring the local ordinances which prohibit its use unless under proper conditions.

The situation in Manhattan and The Bronx remains serious. The dealers have no supplies but are able to keep their large customers supplied with the aid of the new zone system. Conditions in The Bronx are more acute, the receipts of coal there having been prevented by heavy ice blocking the canals and creeks. In Brooklyn conditions have improved. The breaking of the ice in the Gowanus Canal and Newtown Creek released many thousand tons of coal. In Queens there has been a decided improvement, many cars of coal having been sent through the Pennsylvania tubes.

A committee of aldermen has been appointed to conduct "any investigation that may be deemed necessary on the subject of the method of storing, distributing and retailing coal," and to "inquire into all matters of concern relating thereto insofar as said subject is of concern to the city or its inhabitants."

The shortage of anthracite steam sizes is not so acute, but there is no surplus.

Current quotations, per gross tons, f.o.b. Tidewater, at the lower ports, are as follows:

	Circular	Individual
Broken	$6.30	$7.05
Egg	6.20	6.95
Stove	6.45	7.20
Chestnut	6.55	7.30
Pea	5.05	5.80
Buck Wheat	4.30@5.00	5.50@5.80
Rice	3.75@3.95	4.50@4.80
Barley	3.25@3.50	4.00@4.25
Boiler	3.50@3.75	.....

Quotations for domestic coals at the upper ports are generally 5c. higher on account of the difference in freight rates.

Bituminous—The heavy demand for bunker supplies and the curtailment of receipts because of the heavy snow storms and bad rail transportation caused a decided shortage of coal at this market. There is a big shortage of coal in the Metropolitan district, the demand from cities and towns in other parts of the state being just as heavy.

The work of clearing the harbor of vessels held up because of the lack of bunker fuel is progressing rapidly.

The new price fixed for Maryland coal and in mines along the Western Maryland road in West Virginia affects from 30 to 40 companies, many of which have New York offices.

The situation in the manufacturing district of New Jersey close to the waterfront opposite New York is extremely serious, it being feared that many factories will have to suspend unless supplies are received shortly. It was also stated that several up-state gas plants are in bad shape because of the lack of fuel.

Operations at the mines have been bad, some mines not averaging more than three days a week. Car supply is poor, mines along the Pennsylvania receiving about 5 per cent. of their requirements, while those along the New York Central have been getting close to 40 per cent. of their quota. It was said that some of the mines along the Pennsylvania received about 13 per cent. of their normal supply of cars in January.

Many tradesmen are concerned over conditions that may exist after Mar. 31, when a majority of their contracts, many of them made on a basis of from $3 to $4, will expire. No word has come thus far from the railroads or big companies as to the course they will take.

The local situation shows a slight improvement, although supplies at the piers are about as low as they have been in some time. New England continues to get its share of the local receipts.

PHILADELPHIA

Anthracite shipments helped by milder weather. Suffering still acute. Use of bituminous increases. Coal stealing serious. Poor preparation causes action to be taken. Distribution plans for next season under way. Culm causing trouble. Steam coals sold up. Bituminous shipments aided by open weather, but critical conditions continue. Domestic confiscation felt. Question of price of seized coal. Contract rumors. Zoning delayed.

Anthracite—Milder weather conditions for a week have now afforded some relief, but only to the extent of making the suffering less acute. The shortage of fuel continues unabated. This week Chairman Lewis of the City Fuel Committee announced that his investigations show there are 10,000 families in the city without coal. This shows that the progress toward improving conditions has not been satisfactory.

Early in the week another severe cold spell, with the thermometer below zero, again upset calculations, causing idleness at the mines and greatly interfering with railroad deliveries. The operators reported the temperature as being from 20 to 25 degrees below zero at the collieries and that unusual snows had also prevailed. As a result the collieries lost at least two full working days and the trade here is just beginning to feel the effect of the lack of production on those days. The retail delivery system was also badly crippled by drivers and yardmen failing to report for work.

Much of the soft coal recently commandeered from industrial to domestic use has been gas coal. While the retail dealers show some indifference as to handling it, no one has refused to accept any such consignments ordered by the fuel authorities. While first reports from the consumers were somewhat unfavorable, later reports are that it is meeting with satisfaction. The fuel committee has been so impressed by the results of their experiment that they expect to make further heavy seizures, and in one day recently they diverted 103 cars of bituminous coal to the anthracite retailers. However, by an arrangement with the dealers who have been handling anthracite buckwheat for their steam trade, the bituminous coal is being used to replace buckwheat and this latter size turned over to domestic users. Often also a mixture of both is sold to the family trade.

A new departure was made this week when Chairman Lewis ordered the seizure of domestic sizes of coal which had been stored in retailers' yards by manufacturing plants. In one case 50 tons of egg coal owned and stored by a large baking company was confiscated and the dealer instructed to make deliveries to 50 different homes. Later State Administrator Potter prohibited a dealer from delivering buckwheat from a stock of 1000 tons owned by a large printing establishment and authorized its sale to domestic consumers. Last resort measures are being taken to protect the people in their homes from cold, no

matter how much business may suffer. The alarming number of pneumonia cases, with numerous deaths, as reported by the Health Department, is no doubt having its effect.

A conference to discuss ways and means for relieving the acute domestic shortage was called by State Fuel Administrator Potter after a hurried trip to Washington, where he had conferred with the National Fuel Administration. Attorneys were present to discuss the legal phase of the diversion of coal from original consignees, a practice that is rapidly increasing.

The dealers have been informed by the authorities that they are determined to hold them absolutely to the "householder first" rule, and any ignoring this priority order in the future will be dealt with by the District Attorney. The dealers have been told that so long as there is a single home without fuel none shall be delivered to other consumers. The people have been called upon to report any case of domestic coal being delivered to buildings not occupied as dwellings, while agents of the administration will keep up a vigorous scouting for offenders. Householders who are able to use steam sizes and bituminous mixed are to be given the preference over all other consumers. The committee this week also inaugurated the plan of requiring the dealers to call at the office of the administration and explain just what disposition they have made of their stocks.

The practice of stealing coal from cars after their arrival in the city continues to give much concern. There is hardly a car that does not show the loss of a ton or two. A shortage of 50 per cent. is common, and this week several cars had their entire contents stolen. On his return from Washington State Administrator Potter stated that this city enjoys the unenviable reputation of being the only city in the country where the robbery of cars has got beyond the local authorities, and he has once more appealed to the Director of Public Safety to give better protection to the shipments.

The complaints as to poor preparation of coal has now culminated in an investigation being started by the fuel authorities. An investigation of the quality of coal shipped by anthracite operators, big and little, was certainly in order, more particularly as to the steam sizes. While some shipping companies have said all along that they do not sell culm, inspection of shipments of rice coal lately would indicate that they are no longer taking out the culm. The chief complaint as to the domestic coal is as to size, and numerous complaints have been received by the committee of buckwheat coal being charged for as pea.

Fuel administrators in Luzerne and Lackawanna Counties report that "everything black" is being shipped. A change is now looked for. It has been directed that the standard of preparation as adopted in 1914 must be strictly adhered to. The order will necessitate an inspection at the mines of every car, but even at that should poorly prepared coal come out we cannot imagine a consignee refusing it on this account.

It is understood that some action is on foot to change the entire system of distribution of coal beginning with Apr. 1. This week a meeting of the special committee appointed by the General Committee of Anthracite Operators was held and plans for distribution formulated. This committee, consisting of W. J. Richards, president of the Philadelphia & Reading Coal and Iron Co.; S. D. Warriner, president of the Lehigh Coal and Navigation Co., and Joseph B. Dickson, of New York, recommended that everything be done to increase production, to take measures to maintain the standard of preparation, prevent use of anthracite domestic sizes in manufacturing, list the war requirements for fuel, apportion the output by cities and towns, and lastly to route anthracite from points of production by traffic lines that will afford distribution on the quickest and most economic basis. It is understood that this plan has been presented to the National Fuel Administration and probably has the approval of Chairman Potter, by whom it is rumored it was presented to Dr. Garfield.

With the continuance of the present mild weather all connected with the trade are much encouraged, as the thaw has been general throughout the mining region. Collieries that had suspended are now working again to their full capacity and the car movement is becoming better than for several weeks past. Because of this milder weather locomotives are able to haul nearly full tonnage. Because they claim the "backbone" of winter is broken, many dealers are more optimistic than they have been for months. The operators, however, are still much concerned and fear the possibility of flooded mines hampering operations.

Most shippers continue to disregard the request of dealers to ship certain sizes. They contend that a "car of coal is a car of coal" regardless of size or grade. In fact, most orders read: Any kind, any size and any car.

There continues to be little change in the steam coal market. Everybody is closely sold up and some houses even claim to be filled up with orders for culm. There has been much criticism recently about this latter size, due to the wide publicity given a complaint by a large manufacturer who received some worthless material and made a report to the Washington authorities asking that such shipments be prohibited. The prices for such coals as individuals have to offer are buckwheat, $4.15, rice $3.35, barley $2.35 and clum $1.50.

The prices per gross ton f.o.b. cars at mines for line shipments and f.o.b. Port Richmond for tide are as follows:

	Line	Tide		Line	Tide
Broken	$5.90	$6.05	Buck	$3.15	$3.75
Egg	4.80	6.00	Rice	2.65	3.65
Stove	5.05	6.35	Boiler	2.45	3.55
Nut	5.15	6.40	Barley	2.15	2.40
Pea	3.75	4.65			

Bituminous—As was to be expected, the softening of the weather had a favorable effect on conditions, but only to the extent that it prevented what many predicted would be a complete collapse of the fuel supply. There can be no gainsaying that if the severe weather had continued for another week the results would have been appalling. This is proved by the critical state in which the situation still remains. Coal has probably been received in greater volume than the preceding week, but the former period was the worst so far experienced.

Then again, the manufacturing industry, which is mostly dependent upon bituminous coal, has been hard hit by the heavy confiscation of coal for domestic use. With the easing of the weather conditions the problem of railway motive power takes the forefront as being the chief factor retarding the fuel supply. Even after the mines have received cars they frequently remain for long periods loaded on the sidings waiting to be moved from the collieries.

The amount of coal consigned on strictly commercial orders remains at a low ebb, and even when consignments are made on such orders the chances are much against their ever reaching the original consignee, owing to the many chances of confiscation encountered en route.

There continues to be quite a little discussion as to the price to be paid for coal which has been commandeered by fuel committees in this city and other sections. While it is generally understood that the fixed Government price will apply on many shipments, yet there is still a large proportion of coal being sent out on contracts with higher prices still in effect. So far as we have been able to learn the authorities have been careful in this respect and we do not believe that any shipper will suffer on account of the price received for his coal on this account.

Many plants in this territory continue to be idle for lack of fuel. While the public utilities in this vicinity have not as yet been compelled to suspend, several have been perilously near it and have only been able to keep going by curtailing their hours of operation, even after being helped out with coal seized by the fuel authorities. In this connection the state administrator has made a ruling that before any coal may be commandeered and delivered to an electric power plant, the committee must be assured that all nonessential customers have been cut off. Churches even have been put in this category.

We have recently heard of the willingness on the part of some shippers to enter into contract relations with certain essential plants on the basis of the Government figure. While this gives no particular present advantage to the producer, yet with higher priced contracts expiring they are placed in the position of being compelled to market their coal at the $2.45 figure anyway, and it seems to be a good policy to tie up to some good concerns who will develop into desirable customers when normal conditions arrive.

BALTIMORE

Warmer weather brings improved railroad movement and a better coal supply, although the situation is still acute. Anthracite receipts far below requirements. Industries short.

Bituminous — Although the railroads benefited materially in movement through the milder weather conditions of this week, the deliveries of soft coal here are still far short of requirements. Many industries are desperately short of fuel, and only by skimping and cutting down production in many cases were they able to continue operation.

Over Sunday the fuel administrator was able to report the unloading of 114 cars of bituminous and 79 cars of anthracite for local use, but as much of this went to public service corporations and for domestic call, there was not much relief for hard-pressed industries. At times the number of bituminous-laden cars unloaded in 24 hours drops back to 40 or 50. Industries with Government contracts were in several instances forced to cut down work.

President Willard of the Baltimore & Ohio spent the past week upon his line to speed up coal movement. The congestion at many points remained serious, however. Lack of motive power to move laden cars or empties is the greatest drawback. Industries here, spurred on by demurrage charges or appeals to patriotism for quick unloading, have frequently seen the empty cars remain on their sidings for days before being hauled away. Conditions at many mining centers remain unsatisfactory, as there have been numbers of days lost through inability to get cars to load. The recent increases in price allowed in Washington are expected to be reflected here, although at present no one worries much about price.

Anthracite—The little anthracite received here is quickly gobbled up. The domestic trade is using much soft coal now, or has given up hope of any coal at all and is relying on oil or gas heaters. Thousands of homes are still without fuel. Many dealers, with uncertain supplies, have been forced to cut down in regard to equipment. It is a serious matter to have many wagons and men with no coal to deliver for days at a time. The result has been that when coal came through in many cases there was no means of delivering it promptly. Consumers are frequently told that they can get coal if they will arrange to have it hauled.

Lake Markets

PITTSBURGH

Pittsburgh zone defined. Practical operation being arranged. Four lower pools of Monongahela open. Car supplies better with milder weather.

R. W. Gardiner, zone distributor for the Pittsburgh district, was in conference with the Fuel Administration at Washington the last two days of last week and is now taking the first active steps toward putting the new system of distribution into operation for the Pittsburgh district. The zone to be served by the Pittsburgh district is roughly the triangle made by running lines from Pittsburgh to Lorain, Ohio, and Rochester, N. Y., respectively. This triangle practically includes in their entirety all the roads that haul coal north from the Pittsburgh district as well as the mines north of Pittsburgh, as follows: The three divisions of the Pennsylvania Lines West, reaching Cleveland, Ashtabula and Erie respectively; the Pittsburgh & Lake Erie of the New York Central system, with connection at Youngstown with the Erie R.R.; the Bessemer railroad, reaching Conneaut Harbor; the Buffalo, Rochester & Pittsburgh and finally the Allegheny Valley division of the Pennsylvania. A meeting of coal operators will probably be held about the beginning of next week to adjust various matters in connection with operating the zone system.

At the beginning of this week the Monongahela River began to fall, without the gorges at Brownsville or Morgantown having broken, so that the fifth and higher pools are closed, while mines in the fourth and lower pools are resuming. After a practically complete cessation of river coal movement for more than five weeks, more than half the river mines upon which various Pittsburgh consumers depend are in line for full operation, except that a few tipples have been destroyed.

Car supplies at the rail mines have been improving, there having been mild weather beginning Wednesday of last week. Pittsburgh observed heatless Monday this week, but believes weather conditions are such that the Fuel Administration's order in this matter will be rescinded before next Monday.

Ordinary open market transactions in coal amount to practically nothing, but technically there is a large turnover of coal at the set prices, caused by the various orders of the Fuel Administration. The market remains quotable at the set prices: Slack, $2.20; mine-run, $2.45; screened, $2.70, per net ton at mine, Pittsburgh district, with 15c. additional permitted to be charged in the case of sales by brokers.

TORONTO

Coal very scarce. Shipments altogether inadequate to increased demand. Many dealers' offices closed. Three heatless days ordered by government.

The coal situation is worse than ever, and many cases of suffering are reported. About 225 cars of coal arrived here on Feb. 3, but the supply was altogether inadequate for the demand and since then comparatively little has come in. Some of the large dealers had to close their offices, being unable even to fill small orders. Conditions have been aggravated by the fact that many consumers who had laid in stocks to carry them over the winter have found their supplies insufficient owing to the extreme cold, and are now buying from hand to mouth. Many of the smaller dealers, finding themselves entirely unable to get supplies, have gone out of business. At some yards orders are only being filled for those who could undertake the delivery themselves. The civic authorities, churches and charitable organizations are endeavoring to relieve cases of extreme necessity.

The government has ordered three heatless days, Feb. 9 to 11, on which manufacturing plants and business places heated by coal must close down. This is expected to improve conditions considerably.

Nominal quotations for best grades per short ton are as follows: Retail anthracite: Egg, stove, nut and grate, $9.85; pea, $8.85; bituminous—steam, $9; slack, $8 to $8.50; domestic lump, $10; cannel $11. Wholesale, f.o.b. cars at destination, three-quarters lump, $7 to $7.50; slack, $6.85 to $7.

DETROIT

Moderating weather conditions avert suffering for those without coal and permit freer movement of shipments. Public schools are closed.

Bituminous — Rising temperatures, for the present, have saved Detroit from what threatened to be a most serious situation for both domestic consumers and users of steam coal. With shipments cut off by reoccurring snowstorms and zero temperatures, residents of the city were confronting almost certain hardship and suffering, when a change in weather conditions brought restoration of hope.

Though coal supply has not improved and all public schools of the city are closed, the fact that more moderate temperatures prevail is a comforting condition. Through the aid of Federal Government agencies relief has been afforded the Detroit City Gas Co., on which many homes were wholly dependent for heat. Shipments of gas oil are reported on the way from Chicago and arrangements have been made by the local representatives of the state fuel administration to assure the company's coal supply.

Anthracite—Little anthracite is coming into Detroit. Household consumers in most cases find it impossible to get their needs supplied as few of the retail yards have been able to get anthracite. Shipments of wood from the interior of the state have been arriving in small volume, but wood fails as a substitute for anthracite. The wood, cut to 16-in. lengths, sells around $8 a cord delivered, which makes its use rather costly in the opinion of consumers. Coke is almost unobtainable at present and brings hard-coal prices when it is to be had.

COLUMBUS

With warmer weather, operations at Ohio mines have been improved. There is still a serious shortage in both domestic and steam grades.

The coal trade in Ohio has been bettered to a marked degree by the breaking of the severe winter weather and the fact that the snow and ice are melting gradually. This means reduction in the supply of fuel necessary for domestic consumption and the helping of transportation. With less cold weather, it is believed that the worst of the situation is now passed.

The condition of the domestic trade still remains a feature. Efforts of county and state administrators have been devoted almost exclusively toward supplying the needs of householders. Rush orders were made for the shipment of coal to certain points where the scarcity was acute, and the Federal Fuel Administration was called upon frequently to make certain rulings. As a result of these efforts central Ohio was fairly well supplied. Considerable suffering, however, was reported from western and northwestern Ohio, where the coal shortage was extremely severe. Dealers were still controlled as to the amount to be delivered to each customer. Reserve stocks in the hands of dealers have been low, and in many cases they were entirely exhausted. Prices have been firm at the levels fixed by the county committee. Pocahontas is quite scarce, and there is also a scarcity of West Virginia splints. Anthracite is now almost entirely out of the market.

The steam business has been strenuous in every way. Large users have been compelled to stand aside while coal they have on the way has been diverted to private users. The county committees, working in conjunction with the state administration, have succeeded in keeping most public utilities going.

The production in Ohio fields showed an increase toward the latter part of the week. This is especially true in the Hocking Valley field, where the output is estimated at 55 to 60 per cent. of the average. In eastern Ohio shortage of cars and motive power are still holding up production. Massillon and Crooksville are credited with about 45 per cent. of normal.

Prices on short tons, f.o.b. mines, are as follows:

	Hocking	Pomeroy	Eastern Ohio
Sized grades	$2.70	$3.05	$2.70
Mine-run	2.45	2.70	2.45
Screenings	2.20	2.45	2.20

CINCINNATI

More moderate weather and the receipt of coal by rail have enabled the relief of domestic consumers, but the industrial supply is limited. Flood stage in the river adds to complications.

A sudden change from below-zero weather to temperatures above freezing helped to relieve distress among domestic consumers in Cincinnati, while the receipt of 100 carloads of coal from the concentration yards at DeCoursey, Ky., served to give retailers a supply of coal to distribute to their patrons. Many dealers had been entirely without coal for their trade, so this served to relieve a situation which was becoming serious. The shortage of fuel was complicated early this week and during the latter part of last week by the high flood stage of the Ohio River, brought about by ice gorges that dammed the stream completely and forced it to back up higher than is usual even in severe spring floods. The river has been gradually receding, however, so that river-front coal yards can now operate. The principle difficulty is still that of supplying manufacturers with fuel for their plants, many having been forced to shut down due to lack of coal. Others have been operating on a narrow margin. The railroads have been unable to reach normal operating schedules on account of the ice on their tracks, coupled with the severe cold. It is hoped that the worst of the winter weather is over, and that conditions will improve steadily from now on.

LOUISVILLE

Moderating weather has reduced demand and given dealers and carriers a chance. Flood waters in mining districts have subsided, and production is expected to increase. Conditions show material improvement.

Production of coal in the eastern Kentucky fields was reduced to a minimum during a period extending from Jan. 23 to Feb. 2, as a result of the high water experienced throughout the coal district because of melting snow. Few mines were flooded, as most of the operations are high in the hills.

The high water meant a still further shortage of cars, and this combination of circumstances resulted in a light production for the district. However, now that the water has gone down and the railroads are getting back into shape, it is expected that with moderate weather there will be an improvement in conditions.

An interesting feature of the week has been the movement of mine-run coal from the western Kentucky mines into Louisville in box cars, it being handled much in the same way as coke has been handled in such cars in the past. There is a shortage of open cars and some miners are willing to accept any kind of equipment. The small dealers and some small car-lot consumers are glad to accept such coal, but the larger dealers claim that it involves too much labor in handling and are opposed to accepting it.

BIRMINGHAM

Shortage of both steam and domestic coal continues acute, though warm weather is relieving the situation to some extent. Demand for both grades brisk, as domestic dealers endeavor to accumulate stocks, and the steam trade hustles for current needs. Production slightly better than last week.

While the demand from the householders for domestic coal has assumed a normal status, the retail dealers are endeavoring to accumulate sufficient stocks to tide them over future cold snaps. While weather conditions have not been severe in three weeks, spring temperatures prevailing most of that time, not a yard in the eastern section of the city has any coal on hand.

Alabama, along with the other Southern states, has experienced its last "heatless" Monday, and normal industrial operations were observed and business was conducted as usual last Monday. There has been no diminution noted in steam-coal requirements—inquiries being strong and urgent. The priority clause in the Fuel Administrator's order remains in force, and preferential industries and public utilities will continue to receive their fuel supply, if need be, at the expense of operations not considered of vital import to the welfare of the nation.

Production at the mines was somewhat better than the previous week, though far from normal, as yet. Operations are not suffering materially for lack of cars, the supply being satisfactory in most cases.

Coke

CONNELLSVILLE

Car supplies improving. No prospects of river shipments in near future. Byproduct ovens doing better.

Car supplies have been improving since zero weather disappeared Tuesday of last week, but the recovery of the railroads, even with the mild weather of the past few days, has been very slow. The smallest shipments of any week since early in 1915 occurred week before last, representing only a trifle more than half the coke requirements of the blast furnaces depending on the region. Last week's shipments were only a trifle better, on the whole, while this week promises to show a material improvement. During January a considerable part of the accumulation of coke between ovens and furnaces was moved, but this did not seem to afford the furnaces much relief, and furnace operations have been very light, only an occasional furnace having been able to resume in the past few days.

River shipments of coke stopped the first week in the year by ice in the Monongahela River are not likely to be resumed in the near future. The ice gorge at Brownsville, in the fifth pool, is holding, with the river now falling, and this shuts off all coke movement.

The byproduct ovens are gradually increasing their operations, being better supplied with coal, and are this week operating at a trifle above 75 per cent. of capacity.

The market remains quotable at the set prices: Furnace, $6; 72-hour foundry, selected, $7; crushed, over 1 in., $7.30, per net ton at ovens. The Fuel Administration has not made the recently expected ruling to allow a brokerage on coke as is allowed on coal, and it is quite doubtful now whether any action will be taken.

The Connellsville "Courier" reports production in the Connellsville and lower Connellsville region in the week ended Feb. 2 at 214,658 tons, a decrease of 7077 tons, and shipments at 228,539 tons, a decrease of 38,882 tons.

Birmingham—Coke producers report a brisk inquiry from a wide range of territory but admit inability to provide for more than their usual line of customers, deliveries on contracts in many cases being far behind. However, the car supply has shown considerable improvement and restricted routing eliminated to such an extent as to enable producers to make more liberal shipments to Texas and Pacific Coast territory. When deliveries are caught up with on this business it is expected that there will be some free tonnage for the spot trade. The fuel administrator has allowed an advance in the oven price on beehive coke, Big Seam furnace coke being increased from $6 to $6.75, Yolande and Brookwood foundry from $7 to $8, and Empire from $7 to $8.25 per net ton ovens. Under present market conditions the increased figures will not affect inquiries in the least.

Middle Western

GENERAL REVIEW

Warm weather helps solve the panicky market conditions.

The first two days of last week found the market generally without fuel. Zero to 15 deg. below prevailed throughout the Middle Western section, and this temperature came at a time when the railroads were paralyzed and dealers and industrial plants were without coal. Since Wednesday warmer weather has prevailed, however, thereby greatly relieving the distress and affording the railroads an opportunity to move some of the badly needed coal.

Coal cars are still scarce, however. If present weather conditions continue, no doubt there will be more cars available, and a little fuel will be accumulated at points where relief is the most needed. Mine operation has not been above 65 per cent. in any locality, and in most fields it fell far below this figure. The movement of coal in both Indiana and Illinois has been confined largely to these respective states, which is in accord with the instructions of the state fuel administrators, that localities producing coal should be served first.

Northern Illinois has always been a large user of Indiana coal, but the withdrawal of Indiana from this market has put a heavier burden on the Illinois operators and has created a new trade relationship.

Warm weather has caused the snow to disappear in southern Illinois and Indiana, enabling the refilling of ponds and reservoirs with a sufficient supply of water. The lack of water has long been a source of delay and expense to many mine operators, as water cars could not always be moved when needed, due to insufficient motive power of the railroads.

CHICAGO

Chicago is still short of fuel, due to inadequate transportation facilities.

At the instance of Fuel Administrator Raymond E. Durham, Chicago was divided into 12 districts, and dealers undertook to supply fuel to those most urgently in need of it. District 12 was found to contain about 10 tons of anthracite and 75 tons of bituminous. Other districts were found to be in little better shape. At the time the survey was made it was claimed that at least 500,000 tons of fuel was tied up in various yards in and near Chicago and en route, this being held up or delayed because of insufficient motive power. This state of affairs clearly indicates that transportation and not production has been causing so much trouble.

This market has been independent practically of Western coal for some time, and the fact that Indiana coal has been held out of Chicago for several days has increased the demand made on Illinois operators and the railroads serving their mines.

Anthracite and eastern bituminous coals are indeed scarce in this market, and only an occasional car of Kentucky coal is arriving here.

Quotations in the Chicago market are as follows, per net ton f.o.b. cars at mines:

	Williamson and Franklin	Saline and Harrisburg	Fulton and Peoria	Springfield	Carterville	Grundy, La-Salle, Bureau and Will
Steam lump	$2.65@2.80	$2.65@2.80	$3.00@3.15	$2.65@2.80	$2.65@2.80	$3.35@3.50
Domestic lump	2.65@2.80	2.65@2.80	3.00@3.15	2.65@2.80	2.65@2.80	3.35@3.50
Egg or furnace	2.65@2.80	2.65@2.80	3.00@3.15	2.65@2.80	2.65@2.80	3.35@3.50
Small egg or nut	2.65@2.80	2.65@2.80	3.00@3.15	2.65@2.80	2.65@2.80	3.35@3.50
Stove	2.65@2.80	2.65@2.80	3.00@3.15	2.65@2.80	2.65@2.80	3.35@3.50
Chestnut	2.65@2.80	2.65@2.80	3.00@3.15	2.65@2.80	2.65@2.80	3.35@3.50
Pea	2.65@2.80	2.65@2.80	3.00@3.15	2.65@2.80	2.65@2.80	.....
Washed egg	2.65@2.80	.....	.....	.....	2.65@2.80	3.35@3.50
Washed stove	2.65@2.80	.....	.....	.....	2.65@2.80	3.35@3.50
Washed nut	2.65@2.80	.....	.....	.....	2.65@2.80	3.35@3.50
Mine-run	2.40@2.55	2.46@2.55	2.75@2.90	2.40@2.55	2.40@2.55	3.10@3.25
Screenings	2.15@2.30	2.15@2.30	2.50@2.65	2.15@2.30	2.15@2.30	2.85@3.00
Washed slack	2.15@2.30	.....	.....	.....	2.15@2.30	2.85@3.00

	Clinton and Sullivan	Knox and Greene	Eastern Kentucky	Smokeless: Pocah. and W. Va.	Smokeless: Penna.	Hocking	West Va. Splint
Dom. lump.	$2.65@2.80	$2.65@2.80	$3.10@3.25	$2.60@2.75	$2.60@2.75	$3.05@3.20	$2.85@3.00
Steam lump	2.65@2.80	2.65@2.80	3.10@3.25	2.60@2.75	2.60@2.75	3.05@3.20	2.85@3.00
Egg	2.65@2.80	2.65@2.80	3.10@3.25	2.60@2.75	2.60@2.75	3.05@3.20	2.85@3.00
Small egg or nut	2.65@2.80	2.65@2.80	3.10@3.25	2.60@2.75	2.60@2.75	3.05@3.20	2.85@3.00
Mine-run	2.40@2.55	2.40@2.55	2.85@3.00	2.40@2.55	2.45@2.60	2.70@2.85	2.60@2.75
Screenings	2.15@2.30	2.15@2.30	2.60@2.75	2.10@2.25	2.10@2.25	2.55@2.70	2.35@2.50

MILWAUKEE

Supply of hard coal is exhausted. Coke manufacturers return all orders to dealers, because of inability to catch up with the demand. Interior cities in a bad way, because of lack of fuel.

Milwaukee coal companies have announced that the supply of hard coal is exhausted and that nothing but the bituminous varieties can be furnished in future. Thousands of families employing stoves and heaters which are not adapted to the use of soft coal are hit hard by the famine, but dealers and the fuel administrators can offer them no relief. Coke producers have returned all orders to retailers and will do their best to meet the demands upon them without priority obligation. There has been no change in the price schedule.

W. N. Fitzgerald, state fuel administrator, says there is plenty of coal at Wisconsin lake ports, but that the weather and rail situation hampers the movement of it so that it is impossible to get coal to interior points as fast as it is needed. This is the chief problem which faces the fuel administration. At present it is impossible to average more than 15 carloads per day. A few days of warm weather during the past week made things look a little brighter, but a sleet storm which followed upset all optimistic calculations.

Demands for coal from interior cities become more urgent every day, and at many places the schools have been closed because of a lack of fuel. Southern counties of the state are seriously affected by the holding up in Indiana and Illinois of coal in transit. No coal has been received from these states in weeks. The matter has been taken up with the Federal Fuel Administration and it is expected that a drastic order to Indiana and Illinois administrators will be the result. A former order in this regard has been ignored by the latter.

County fuel administrators are trying to get in touch with owners of summer resorts and homes which have been closed for the winter, in order to take advantage of fuel lying in the bins.

The canvass by the State Council of Defense to obtain estimates of the amount of coal which will be needed next year is progressing, and reports have already been received from many cities of the state. The plan is to move all coal to central lake ports next season and then to distribute it as far as possible pro rata to all points within the coal consuming area.

ST. LOUIS

Weather conditions good, and this has helped the fuel situation. Mines working one and two days per week on account of transportation facilities. Tonnage very light from all fields and moving generally to outside markets where need is greatest. Local situation satisfactory.

The conditions at the present time in St. Louis are especially good, considering the plight of other centers. There is no surplus of any kind of coal in the market. As a matter of fact, St. Louis is short; but it is so much better taken care of than any other city that places that are suffering are being supplied with coal from the St. Louis requirements.

The railroads have curtailed production in the Illinois field the past week. The Illinois Central is giving some mines only one and two days' work per week, and sometimes it bunches the cars so that the mines cannot load them. Again it fails to pull loads for fully a week's time. The other roads seem to be holding up far better, and conditions in general show improvement, except as noted above.

Complaint has been made that the railroads are not using their men and equipment so as to get the best efficiency. This complaint comes from the railroad men themselves.

In St. Louis the Terminal, which is supposed to be a unified terminal, continues to use embargoes against different parts of itself as well as against the trunk lines. These embargoes continue to be used in defiance of instructions from the Fuel Administration that embargoes are not legal and not enforceable. These practices continue to cause congestion at East St. Louis and confusion in general in coal trade circles.

In the Carterville field, comprising the Williamson and Franklin County districts, working time still continues poor and the railroads and Government seem to be getting the bulk of the output. It developed the past week that about 80 per cent. of the domestic business in Chicago formerly consisted of Eastern coal, and that it has come to a point where but 20 per cent. is now coming in, the other 60 per cent. being made up from the Illinois and Indiana fields. This has drawn all the coal from the Carterville district, and Chicago still continues to be short. The same conditions exist to some extent in the DuQuoin field. The Rutledge and Taylor Coal Co. there seized the opportunity to cancel all its contracts, claiming that Fuel Administrator Garfield's priority order invalidated contracts.

In the Mt. Olive field the bulk of this coal still goes for railroad purposes, and there is still a shortage of this coal for domestic uses in the St. Louis market.

Railroad facilities in the Standard field have kept the production down, and railroad requirements seem to keep a large percentage of the domestic tonnage out of its usual channels. However, the St. Louis territory is getting its share of this coal and in sufficient quantities to prevent any suffering or factories from shutting down.

Trunk lines other than the Illinois Central are making good time from the mines to East St. Louis with coal, but the trouble is with the Terminals.

There have been some receipts in the past week of anthracite coal, some 25 to 30 cars having come in. There has been nothing from Arkansas nor any West Virginia smokeless.

Fuel Administrator Crossley has removed all local restrictions with regard to fuel conservation, and only those of the Federal Fuel Administrator Garfield are now in effect.

The prevailing market per net ton f.o.b. mines is:

	Williamson and Franklin County	Mt. Olive and Staunton	Standard
6-in. lump	$2.65@2.80	$2.65@2.80	$2.65@2.80
3x6-in. egg	2.65@2.80	2.65@2.80	2.65@2.80
2x3-in. nut	2.65@2.80	2.65@2.80	2.65@2.80
No. 2 nut	2.65@2.80	.....	.....
No. 3 nut	2.65@2.80	.....	.....
No. 4 nut	2.65@2.80	.....	.....
No. 5 nut	2.15@2.30	.....	.....
2-in. scrgs	2.15@2.30	2.15@2.30	2.15@2.30
2-in. lump	.....	.....	2.65@2.80
3-in. lump	.....	2.65@2.80	.....
Steam egg	2.65@2.80	2.65@2.80	2.65@2.80
Mine-run	2.40@2.55	2.40@2.55	2.40@2.55
Washed:			
No. 1	$2.65@2.80	$2.65@2.80	.....
No. 2	2.65@2.80	2.65@2.80	.....
No. 3	2.65@2.80	2.65@2.80	.....
No. 4	2.65@2.80	2.65@2.80	.....
No. 5	2.15@2.30	2.15@2.30	.....

Williamson and Franklin County rate is 87½c. Other fields, 72½c.

General Statistics

NORFOLK & WESTERN RAILWAY

The following tabulation shows the shipments of coal and coke over the Norfolk & Western Railway Co.'s lines during the month of December, 1917, and for the twelve months ending Dec. 31, 1917, as compared with corresponding periods of the previous year. The figures are in net tons.

	December 1916	December 1917	Twelve Months 1916	Twelve Months 1917
Coal: Tidewater:				
Foreign	153,483	93,021	3,307,443	2,280,914
Coa'w'se	227,741	199,229	3,373,072	3,149,992
Domestic	2,124,096	1,591,278	27,680,401	26,993,496
Coke:				
Foreign	1,993	584	48,634	18,453
Domestic	171,755	313,215	1,999,680	2,529,627
Total	2,679,068	2,197,327	36,409,230	34,972,482

The following table gives the coal tonnage from mines on the Norfolk & Western Ry., and from other railroads, for the month of December, 1917:

From	Net Tons
Pocahontas field	987,382
Tug river field	228,311
Thacker field	197,032
Kenova field	89,038
Clinch Valley field	112,922
Other northern and western territory	14,405
Total northern and western fields	1,629,090
Williamson & Pond Creek Railroad Co.	96,220
Tug River & Kentucky Railroad Co.	42,702
All other railroads	81,921
Total	1,849,933